Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

Published by McGraw Publishing Company, Inc.

Volume 74 NEW YORK, SATURDAY, JULY 15, 1916 Number 3

Economize Labor on Repaving Work

A STRIKING example of the tendency to economize human labor in construction work is presented in the repaving under way in Brooklyn, N. Y., described on page 51 last week. From the ripping up of the old wood blocks and the concrete foundation to the mixing of the joint filler the effort to minimize labor is manifest. The only features of the work monopolized by men are the finishing of the subgrade, the spreading of the sand cushion, the actual laying of the blocks and the pouring of the joints—this despite the fact that the work is carried on within very restricted limits and under conditions that at first sight would seem to discourage the use of large machinery. The bulk of the excavation, and the hardest part, is done by a steam shovel, which also loads the spoil on to the trucks. The subgrade is tamped by a steam roller and the concrete foundation is mixed and placed by machine. In mixing the joint filler the labor of five men is saved by the use of a hand-operated mixer, which, though crude, has effected economies. Such examples indicate that the labor shortage due to the European War has not been without some recompense. It is directing the contractors' attention still more forcibly to labor-saving machinery. Cheaper and better construction will be the result.

Changes in Cement Specification

KNOWING that all engineers and contractors would be anxiously awaiting details as to the character of the changes proposed in the new cement specification, sent to letter ballot by the American Society for Testing Materials week before last, the Engineering Record asked R. J. Wig, who is a member of both the Joint Conference and the A. S. T. M. cement committees, to present these changes briefly and give the reasons why the committees recommended them. The article appears on page 71 of this issue. It will be noted that while Mr. Wig, in his closing paragraph, commends the new specification, giving clearly the reasons for his commendation, he also voices the opinion that the specification "is still far from satisfactory as a basis for the purchase of cementing materials." He predicts further and important improvements during the next few years. In this position Mr. Wig is supported generally by engineers who have closely followed the subject. To conclude that the new specification is a resting point is to ignore much of the discussion of recent years and, too, the difficulties that have been met in concrete work. Fortunately the cement committee of the American Society for Testing Materials seems to be working now with great harmony. The dissensions of the past have been forgotten. With the many investigations under way and the submission of the resulting data to a committee which realizes that the unsolved problems in cement manufacture are many and important, Mr. Wig's prediction of further changes in the next few years gives promise of fulfillment.

Expensive Ambiguity

A TIMELY FOOTNOTE to the discussion of ambiguity in specifications (Engineering Record, June 24) is provided by a suit instituted in Philadelphia to recover $50,000 from the city on the ground that the contractor concerned suffered loss to this amount owing to false and misleading specifications for the building of a relief sewer. On behalf of the contractor it is alleged that the city's plans indicated that the sewer was to be built through rock that would not require shoring. It need not be accepted without reservation that "the misleading representations showing the presence of hard rock throughout the greater length of the sewer tunnel were either knowingly or recklessly made for the purpose of influencing the bidding"—this is merely an allegation; but it is easy to agree with the further assertion that the city knew, or should have known, and had means of ascertaining, what was the character of the subsoil. Apparently a serious mistake was made, and the city's plans upon which bids were taken did not represent fairly the conditions under which the work was to be done. These plans indicated that only 225 ft. of a 1900-ft. sewer would go through subsoil that required timbering. According to the contractor it would have been more exact to say that there were only 225 ft. that did not require shoring. Lawyers say that the contractor has a very good case, this conclusion being based on precedents established in suits involving a similar set of facts. However this may be, the incident certainly provides another argument against ambiguity in specifications, whether they be for steelwork or sewers.

The Allies' Economic Conference

THE BRITISH BOARD OF TRADE has published the recommendations for the regulation of the trade of the Allies made at the Paris conference held from the 14th to the 17th of last month. Rumors have been in existence that the post-bellum trade plans of the Allies would be directed not only against the Central Powers but also against neutrals. While the recommendations, as published, do not include any scheme expressly aimed at the trade of neutrals, there will naturally be an effect on the latter because of the plans for bringing about trade co-operation among England, France and Russia. Primarily the recommendations are directed toward preventing trade inroads by the Central Powers. While neutrals cannot object to the arrangement, since it is natural for allies in the tremendous struggle to desire to remain allies during the period of recuperation, the United States must look to her own interests. The very apparent danger is not from the Allies but from Germany. Cut off as she will be, if the recommendations of the Paris conference are adopted, from trade with her powerful neighbors, the fairest game for her will be the United States and those neutral countries to the south of us with whom our merchants have developed new relations since August, 1914. The situation is one warranting the most careful attention by our government departments and our manufacturers. It is obviously most dangerous to adopt measures out of hand. Protection during Europe's time of recuperation must be considered side by side with the long trade pull of subsequent years. A policy that might, from our standpoint, be eminently satisfactory during the recuperative period might merely pile up a toll of retribution for the time when economic conditions are once more normal.

A. S. T. M. Procedure

AS A RESULT of years of experience the American Society for Testing Materials has developed a procedure which seems well suited to the adoption of specifications having so important a bearing on engineering practice and industry as the standards it puts forth. This procedure requires that all proposed standards be printed for one year as tentative before coming up for final consideration and reference to letter ballot. That the plan is good is evidenced by the lack of criticism of it. In order that under exceptional circumstances a specification may be referred to letter ballot at once, without prior printing as tentative, the rules require that there shall be a nine-tenths majority of those voting. The rule indicates that the doctrine that should prevail here is the same as is applied in ejectment proceedings involving land titles—that the decision to eject must depend not on the weakness of the defendant's case but on the strength of the plaintiff's. In other words the proponents of a motion to pass a specification at once to letter ballot must bring the most weighty reasons forward in justification of the course they suggest. There was evidence at the recent meeting of the society in Atlantic City that one committee at least—that on road materials—does not appreciate fully the spirit of the procedure. It asked that quite a number of specifications not hitherto printed as tentative, and some containing amendments which were new, though the specifications themselves were old, be passed at once to letter ballot. While as to some of the specifications the committee on being quizzed from the floor justified its request that there was reason for immediate passage to letter ballot, it was quite apparent that the seriousness of a wholesale violation of the regular procedure had never dawned upon the committee, or at least upon the representatives present on the floor. Quite rightfully there was opposition. While it is but right, when the circumstances are weighty, to waive the regular procedure and invoke the nine-tenths majority rule, only circumstances such as those under which the new cement specification was at once passed to letter ballot should justify the extraordinary procedure.

The Fight Against Efficiency

REFERENCE has already been made in this journal to the bills and riders on various measures now before Congress which would prohibit time studies and other investigations making for higher efficiency in the government service. Fortunately there has been considerable agitation on the subject. There should be far more—in fact, must be far more if these pernicious measures are to be kept off the statute books. One of the best discussions of the subject that this journal has seen is a brief letter written by J. G. White, head of the well-known corporation bearing his name, addressed to several senators and congressmen.

He points out that the only hope which we can entertain for getting any share whatsoever of foreign trade lies in developing an efficiency exceeding that of other nations. Our present industrial activity is due solely to the fact that the nations at war must come to us for supplies and, also, that they are now unable to compete for foreign business on account of their preoccupation in Europe. After the war, he predicts, the situation will be vastly changed and we shall be put to a most severe test by Europe's efforts to take care of its huge debts and rehabilitate its financial systems. If when the country faces such a situation its government, acting quite contrary to that of Germany, for example, which has always tried to set the highest standards in governmental affairs as an example for its industries, should declare that it will prevent studies to increase efficiency, it will give public encouragement and backing to misguided labor leaders who are trying to prevent the introduction of more efficient industrial methods.

As a striking example of what can be done where the restriction-of-output policy does not obtain, it is interesting to know that Sir William Beardmore in his presidential address before the Iron and Steel Institute of England, in May, said that in his factory, making munitions, girls with only three weeks' training and under exactly the same conditions, had turned out double the number of shell bodies as had the trained mechanics. In the boring of shells the output also was double, while in the curving, waving and finishing of shell bases the output was 120 per cent more than that of experienced men. That the women were not overworked, Lloyd-George's well-known ideas on social justice give assurance. This case shows not only the possibility of securing greater industrial efficiency, but indicates that pressed by circumstances the European nations have developed an efficiency in production during the last two years that they never dreamed of before.

It is imperative for the future of this country that we likewise aspire to and attain a higher industrial efficiency. That this may be done the government of the United States should set the example. The passage of the anti-time-study and anti-efficiency measures by Congress will not only discourage efficiency but will impel labor to wage an unceasing fight, even in private plants, against methods for obtaining the greatest possible output for a given expenditure of effort. With labor's determination not to be exploited, whether under the name of efficiency or otherwise, all right-minded men agree. But more efficient methods do not necessarily mean exploitation. In fact, true efficiency, which includes contented and properly remunerated labor, and exploitation are incompatible.

A Sensational Submarine Feat

THE ARRIVAL in Baltimore the other day of the submersible liner "Deutschland" is from an engineering as well as from a strategic standpoint one of the very notable feats of the many which the present war has produced. There have been long voyages of the submarines before, even across the Atlantic from Halifax to the English Coast, and from some point in Germany round through the Mediterranean. In the former instance, however, the craft did not have to run submerged, and in the latter a friendly or at least a neutral shore was never very distant.

It is a long step from ordinary submarine cruising to a cargo-carrying passage across the Atlantic. A submersible blockade runner, such as the "Deutschland" should properly be called, involves some problems quite different from the construction of a fighting submarine. The latter must be extremely quick in maneuvering, must carry armament besides her torpedoes, and must be able to submerge with great speed. On the other hand, the fighting submarine does not have to be very large, for ordinarily she never need operate far from her base. Of course, the larger the fuel capacity the better, yet experience has shown that it is not difficult to pick up gasoline tanks off a secluded spot on a neutral shore or even to have a fairly convenient base of supplies there. It is comparatively easy to get good speed under these circumstances, for all the capacity can be utilized for munitions and fuel.

The cargo-carrying submersible is a different problem. In order to make it possible to carry an amount of goods which would justify a transatlantic voyage she must be big and have a large storage capacity for fuel as well as for cargo. Reports indicate that the "Deutschland" is somewhat in excess of 300 ft. in length and of perhaps 30-ft. beam. Such a boat evidently cannot be overloaded with storage battery for submerged running, yet must be able to make fairly good headway when operating on the surface. It is no mean feat to design a craft of this sort able comfortably to weather the transatlantic voyage when heavily loaded and nearly awash, while yet retaining ability for prompt submergence and a fair speed under water without leaving a telltale wake behind. It implies greater structural strength than in case of a fighting boat, both on account of the strains encountered in running through a sea and for the power to maintain the deep submergence necessary to avoid traces of her progress being visible from the surface.

Apparently all these requirements have been well fulfilled in the "Deutschland," which seems to have made some two-thirds of the distance on the surface, although she had to make long under-water runs in dodging the British blockading fleet. Congratulations are certainly due on this feat of under-seamanship. That she got through the rather loose patrol which had to extend far along our Atlantic Coast is not remarkable, but getting out of the Chesapeake will be a considerably more difficult feat than getting in. Chesapeake Bay is shallow and while the returning "Deutschland" will be safe within the three-mile limit she cannot well pass out through the Capes untrailed. Then it will be a game of hide-and-seek and the safety of the returning freighter will be dependent on her ability to work submerged with never a bubble or an oil drop to disclose her path. If she departs successfully it is quite safe to say that there will be plenty of other visits of the same character and another entirely new feature will be added to the intricacies of naval warfare. What the end of this submarine engineering will be is hard to say, but one can easily imagine much larger craft built with the "Deutschland's" experience in view, and quite able to carry enough cargo to make blockade running well worth the while.

Scathing Arraignment of Reclamation Service Agitation

LAST winter, after a careful inquiry into conditions on the projects of the U. S. Reclamation Service, the Engineering Record expressed itself most emphatically on the reasons for the present conditions. It stated that other factors than the alleged high cost of the irrigation works were chiefly responsible for the unsatisfactory conditions, characterized as disgraceful the hearings before some of the boards of cost review, and laid the bulk of the agitation to the door of the speculators and not of the farmers. The first issued report of the Central Board of Review not only supports these contentions as to the Carlsbad project, but is far more severe than was this journal. In other words, there is now official sanction of the position taken by the Engineering Record.

While the Central Board's report is on only the Carlsbad project, its comments on the speculator are general. As to the hearings and the difficulties, the Engineering

Record takes full responsibility for saying that, while not so noisome, the hearings on some of the other projects have followed in the main the disgraceful spirit shown at Carlsbad, and that elsewhere, also, other things than the cost of the works are responsible for the failures.

The Central Board of Review, it will be remembered, was appointed by Secretary Lane to pass on the reports of the local boards which reviewed the costs on individual projects. It consisted of Dr. Elwood Mead, chairman, Brig.-Gen. William L. Marshall and I. D. O'Donnell. Dr. Mead is a recognized authority on reclamation matters and was formerly chairman of the State Rivers and Water Supply Commission of the State of Victoria, Australia. General Marshall, formerly Chief of Engineers of the U. S. Army, has for years been consulting engineer for the Secretary of the Interior. Mr. O'Donnell is supervisor of irrigation of the Reclamation Service and is generally conceded to be one of the most successful irrigators in the West. The Board, therefore, is thoroughly competent to discuss irrigation matters, while the eminence of its members warrants more than usual consideration of its utterances.

The Central Board's review, published in the July number of the "Reclamation Record," opens with a scathing condemnation of the majority report of the local board. Not only was that report published before it was submitted to the Secretary of the Interior, and even before the minority report was written—a most irregular and unwarranted procedure—but it contains lurid and unfounded comments that did the government a gross injustice. Then in the fullness of the malign spirit that actuates the speculative element, this report and these lurid comments, unfounded and irregularly released, were sent to the water users on each project. The remissions of legitimate charges against the project recommended by the majority report, so the Central Board states, "encouraged water users elsewhere to ask for similar and equal reductions. An impression was created in widely separated localities that the purpose of these boards was to reduce project costs rather than determine them."

A quotation will serve to show the mental state of the two signers of the majority report of the local board. It is part of the comment prepared by the chairman and issued with the report:

"The water user had no voice or vote in the selection of either [engineers and watchmen employed by the Reclamation Service] and had neither the right to hire or fire, and yet he is absolutely compelled to agree to another increased construction cost per acre or let his land go back to the wilderness.

"He has only the right to pray and pay. . . .

"And now realizing the total costs, with all reverence and with a full realization of the present conditions obtained by careful research, I utter the prayer:

"God pity the water user on the Carlsbad project."

The impression which comments of this sort will make can well be imagined. As to the justice of the first statement the Central Board finds that the water users, voluntarily in November, 1911, asked for a further appropriation and agreed to pay the full cost. In other words, they fully accepted the stipulated cost and were not forced "to agree to another increased construction cost per acre," as the chairman of the local board states.

Being of such a mind it is not surprising that the majority recommended that the government reduce the cost of the project to the settlers by $514,021.29—more than half of the total of $933,840.96 which the government had spent on it. With this recommendation the Central Board disagrees, though there are certain items which it recommends be investigated and an adjustment made if the facts warrant it. The board also recommends that the administrative expenses of the Washington office and the cost of making and installing certain wooden gates be not charged against the water users.

Of course, the majority members did not take their ideas from their imaginations. The review of the Central Board leaves no doubt whatsoever as to the source of the misconceptions, and it is to this feature of the report that the Engineering Record directs special attention. The speculative landholder is to blame, and in so declaring the Central Board bears out the contentions made in this journal in the issue of January 1 this year. Though lengthy the board's comment puts so forcibly and well the crux of the situation that it deserves quotation in full. Moreover, having quoted it there will be little need for comment. It carries full conviction. Says the Central Board:

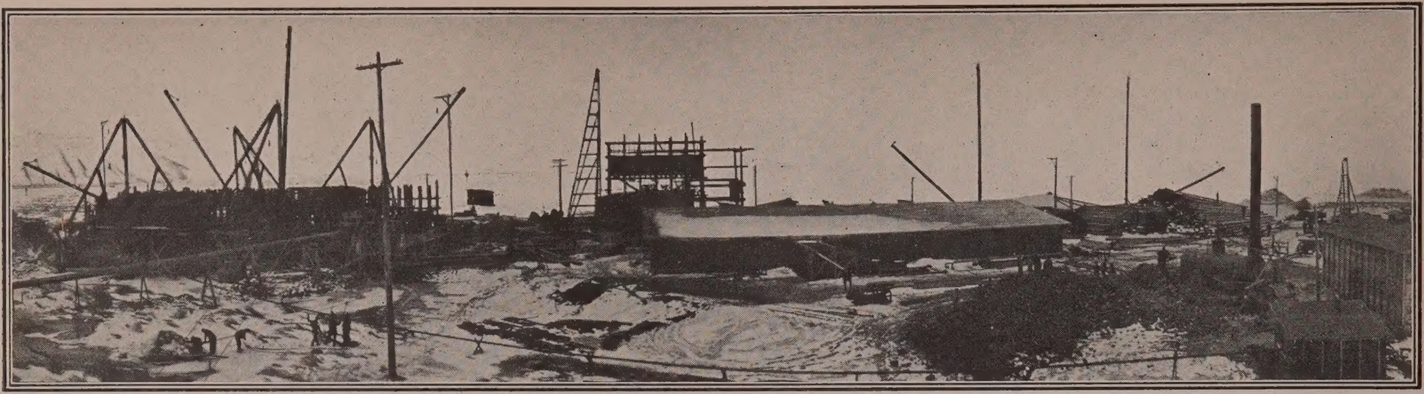
"The speculative landholder on our irrigation projects and his allies, the usurer and the real estate commission dealer, as a rule invest no money in improving or cultivating land. They produce nothing and have no intention to produce anything from the soil. They rely for their profit on the necessities of the settlers and farmers and on the unearned increment due to rise in land values from the mere fact that they were irrigable; from the settlement and increase in value of the neighboring lands, due to the sweat of their neighbor's brow, and from the increase in population and local business and trade. They, unfortunately, may always be found at the head and front of every movement to repudiate under any and every flimsy pretext, and to cut down the actual and proper cost of irrigation works that alone give value to their own and neighbor's lands and are the only basis of prosperity. They constitute not only no use or value to the project, but are the greatest possible nuisance, handicap, and hindrance to development and progress. This blemish of the reclamation act must be eliminated, controlled or abated before any successful system of land settlement in the arid states can be carried out by the states or general government.

"We can not conceive how it was possible for the local board to overlook this situation, and especially how those who prepared the comments above mentioned regarding the plight of the water user could ignore the fact that the main difficulty of the water user is not high project costs, but inflated land prices and usurious interest rates on borrowed money and deferred payments. . . . Those who are urging that the project costs be reduced because they allege that $30 an acre is all that can be paid for a water right are neither improving nor cultivating farm units, in great areas of idle land held in the names of dummy owners, but are asking the real developer to pay from $50 to $150 an acre for the privilege of doing this. In our judgment, if there is to be any reduction, it should not be at the expense of the reclamation fund, but should come in the form of reduced prices for excess lands. It is the government's investment that has created whatever values exist there, and this investment does not justify the prices that are asked. When one considers the nature of the ownership of the excess lands, one realizes that a reduction in project costs will not benefit the water user or any purchaser of these lands one iota; that reduction will simply go into the pockets of the present speculative owners or increase the value of any mortgage on these lands, or both."

Comment is unnecessary, other than to indicate a hearty concurrence in the board's opinion that the speculative element must be eliminated from the projects. It is a difficult problem, but it must be solved before success can be attained.

It must not be thought, however, that the Central Board absolves the government from all blame. The history of the Carlsbad project, which the board details, shows that the government took up a scheme entirely under private control which had repeatedly demonstrated its capacity to consume the money of investors. What influences there were that resulted in the adoption of a tottering project by the government the Central Board does not say. It makes it very clear, however, that in its judgment the reclamation act did not contemplate the taking over by the government of projects either wholly or almost entirely under private ownership. The Carlsbad project, of course, is not the only private enterprise taken over. Where the government has taken projects of that class the owners at the time the government came have done well. The actual farmer, whose energies and struggles have helped to build up new domains on barren wastes, has paid dearly to the land owners for the increased value created by the government's expenditures.

It is well for the country that the Central Board has spoken so plainly and forcibly on some of the evils that beset the reclamation projects. There has been much misunderstanding of them, particularly in the East. There is no one who would not be most generous in dealing with the projects if conditions were as they are represented—due solely or almost entirely to government mismanagement—and if what were done would redound to the benefit of those who are actually developing the land. The truth being known, however, distinctions will be made, and the sympathy which the hard-working settlers have earned will be tempered by the determination that nothing should be done which will further help the speculators. The Central Board's report should secure the widest publicity.



SINKING 62 X 140-FOOT CAISSON FOR PUMPING STATION IN CENTER OF NARROW 6-MILE CAUSEWAY ACROSS NORTH END OF BEAR LAKE

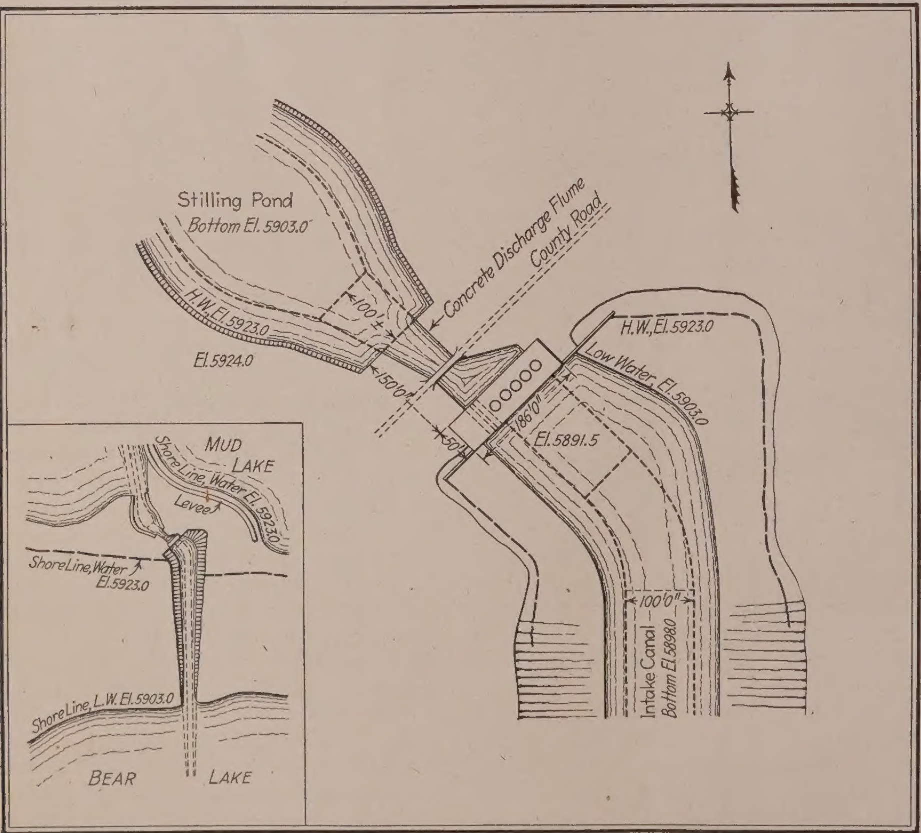
Pumping Station Will Make Deep Idaho Lake Available as Equalizer for Bear River

Continuous Flow Sufficient for Irrigation and Power Developments Will Be Provided Over Any Probable Succession of Dry Years by Drawing Down Big Natural Reservoir

BEAR LAKE, in the Wasatch Mountains on the Utah-Idaho line, with an available storage capacity of 1,300,000 acre-feet, is to be utilized, by the construction of a pumping station rated at 1500 sec.-ft. capacity, as a huge equalizing reservoir which will be filled in periods of heavy rainfall and drawn down during dry years to bring under complete control the flow in Bear River. The flow to be regulated by this station, located at a point called Lifton on a narrow causeway crossing the north end of the lake, will operate four large hydroelectric developments on the river below and will furnish water for extensive irrigation use. Both in point of employing as a reservoir a lake with very large storage capacity in comparison with the annual flow of the river, and of using to draw it down a pumping station driven by power developed from the water pumped, this project is believed to be unique.

TOPOGRAPHY KEY TO PROJECT

A glance at the map is necessary to make plain the reasons for this development. Bear River, flowing north, emerges from the mountains east of Bear Lake, traverses on a slope of barely a foot to the mile the flat mountain valley in which lies the lake, turns west and breaks through the Wasatch Mountains. From this point it runs south to Great Salt Lake on a steeper gradient in which a fall of 865 ft. is utilized by three plants now in operation and one under construction. Thirty miles beyond Bear Lake the river is but 40 ft. below normal lake level, and even to reach this far with a canal a succession of several miles of rocky ridges in the valley floor would have to be cut through. The junction with the river of the outlet canal now under construction, though 16 miles above the lake and as far downstream as a canal can be dug by dredging, is but 11 ft. below the lake level. It was evident that a pumping station would be required if any considerable flow was to be maintained from the lake at stages 4 ft. or more below its normal level. The Utah Power & Light Company, which supplies electric power for lighting, traction, irrigation pumping and mining and industrial plants throughout this territory, and the chief units of whose generating system are on Bear River, therefore decided to add the pumping station to the inlet and outlet canals already built and building to connect the river with the lake.



PUMPING STATION SET AT ANGLE WITH INTAKE CANAL TO AVOID DAMAGE FROM DRIFT ICE

A 12-ft. drawdown would equalize the flow of the river over any succession of dry years recorded, but a maximum drawdown of 21 ft. is provided for to cover any inaccuracies in the records and to make it possible to equalize the power output from streams other than Bear River itself.

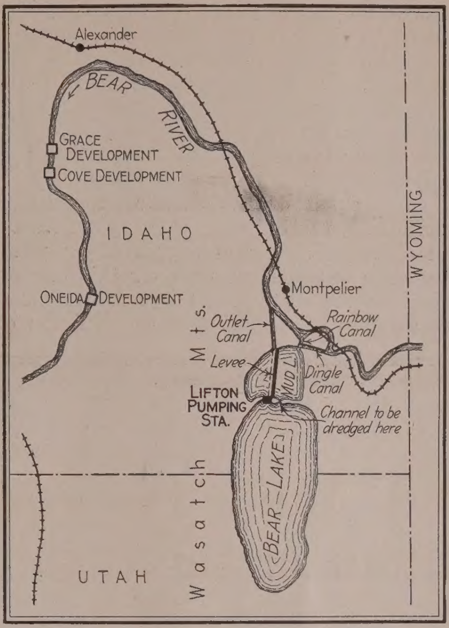
DEVELOPMENT VALUABLE FOR IRRIGATION

Bear River drains an area of 6500 square miles, made up of portions of southwestern Wyoming, southeastern Idaho and northern Utah. The drainage area of Bear River above the lake is approximately 3000 square miles, and the drainage area of Bear Lake itself is about 400 square miles. The capacity of the inlet canals constructed is 5000 sec.-ft., so that practically all flood waters can be diverted into the lake. The four hydroelectric stations located on the river below the lake develop at maximum capacity 67,500 kw.

Irrigation is extensively carried on in the Bear River drainage area, the water being diverted from the main river and from a great many of its smaller tributaries. The regulation of the river for power purposes automatically regulates the flow for irrigation also, and will prevent a shortage of water in dry years and provide water for irrigating large additional areas both by gravity and electric pumping distribution. The depth to which it will be possible to draw down the lake will make more water available for irrigation in the summer months than could be secured by a system designed merely to equalize the flow of the river throughout the year.

LAKE STEEPSIDED

Bear Lake is a deep body of water approximately 21 miles long and 8 miles wide. At the north end there are a large swamp and a shallow lake called Mud Lake, which is 6 miles long and 5 miles wide. The inlet canals through which water is diverted from Bear River discharge in the north end of Mud Lake, and the water then runs 6 miles through this lake into Bear Lake. When Bear Lake has been pumped down 5 ft., practically the entire bottom of Mud Lake will be exposed. In Bear Lake itself the shores are steep and there is little difference in area between the high and low water levels. One foot of drawdown of the lake equals 68,000 acre-feet.

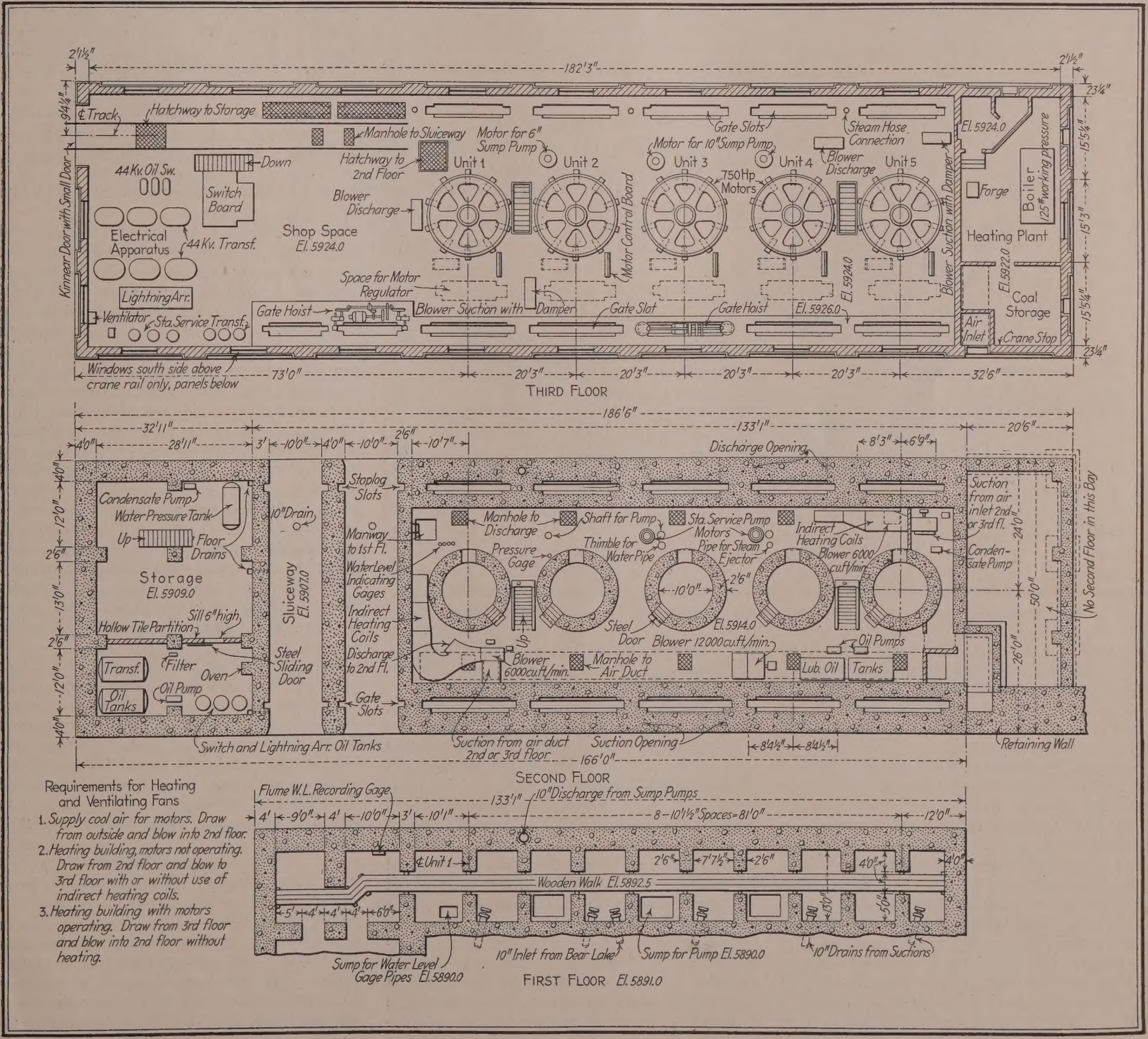


WORKS TO CONVERT LAKE INTO RESERVOIR

There was formerly a natural outlet from the lake to the river, which extended over a very flat swamp and was 20 miles long. It had very small capacity and such a flat grade that during the spring, when the river was at high stages, it is said that water sometimes flowed from the river back into the lake.

OUTLET CANAL HAS FLAT GRADE

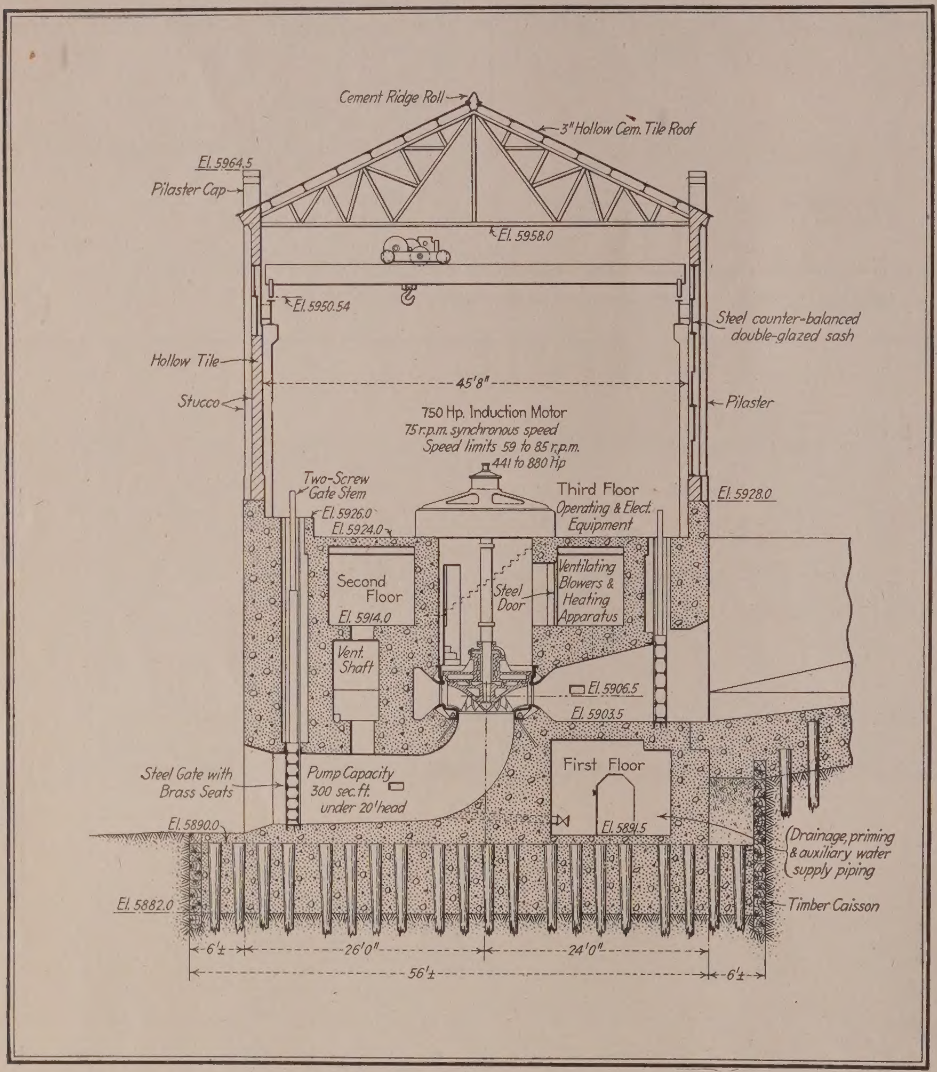
A canal has been dredged across this swamp from Lifton on the north end of Bear Lake 14 miles north to the river at a point called Junction. When the lake is full the surface of the river at Junction is approximately 11 ft. below the surface of the lake. Practically all of this fall is necessary for the canal to pass the maximum flow required. It is possible to draw the lake down by gravity to a depth of 4 ft. by means of this outlet canal, but the rate of flow through the canal is greatly reduced as the lake level drops. The pumping plant, however, will make available the desired storage capacity and at the same time secure the full discharge capacity of the canal at all stages of the lake. The



Requirements for Heating and Ventilating Fans
1. Supply cool air for motors. Draw from outside and blow into 2nd floor.
2. Heating building, motors not operating. Draw from 2nd floor and blow to 3rd floor with or without use of indirect heating coils.
3. Heating building with motors operating. Draw from 3rd floor and blow into 2nd floor without heating.

FLOW OF 1500 SECOND-FEET MAINTAINED BY FIVE HUGE PUMPS—LIFTED 20 FEET HERE, THIS FLOW DEVELOPS TOTAL HEAD OF 865 FEET BELOW plant is located on the upper edge of the lake, at the head of the outlet canal, and will develop the maximum capacity mentioned of 1500 sec.-ft. at 20-ft. head, although to equalize the flow in Bear River below the lake over an average year it will be necessary to use only three of the units and to lower the lake level only 3½ ft.

Five vertical-shaft units with a nominal capacity of 300 sec.-ft. each will be contained in the pumping station. As the head will vary from nothing to 20 ft., variable-speed motors and two types of impellers have been provided for better operation at low heads. The arrangement of the principal and auxiliary apparatus in the station and the heating and ventilating system required by the cold winter climate are clearly shown in the accompanying drawings.



SEVERE CLIMATE AND COST OF COAL REQUIRED CAREFUL INSULATION OF BUILDING

It was necessary to locate this station on a sand bar called the Causeway, which extends entirely across the north end of Bear Lake and separates it from Mud Lake and the swamp. All the material about this locality is very fine sand mixed with clay, which extends to unknown depth. The only variation is in the percentage of sand and clay. This material flows readily in water, and the wave action against the Causeway has flattened it out so that the bottom of the lake at the contour line 20 ft. below its normal surface is approximately 2000 ft. from the normal shore line along the Causeway. Heavy wind storms sometimes break up the ice on the lake and pile it up on the Causeway to a height of 10 or 12 ft. For this reason the pumping plant has been located on the north side of the bar, at the head of the outlet channel, and has been set at an angle with the intake channel, so that if ice is forced into the latter it will pass the station and pile up where there are no structures.

On account of the peculiar foundation conditions, the building is being constructed on a concrete mat supported on piles. In order to place and unwater this mat an open wooden caisson 140 x 62 ft. was sunk to a depth of 44 ft. The construction of this caisson, which is one of the largest ever sunk by open dredging, will be described in a future article.

A large intake channel will be dredged through the beach south of the Causeway to the pumping plant. While it is possible that wave action may gradually fill this channel with sand and make its maintenance a difficult problem, the cost of a permanent intake channel would have been so great that it was not considered expedient to build one. The channel will be dredged very large at first and will be maintained by such additional dredging as may be necessary in the future.

The pumping station is now being completed by the Jarrett-Chambers Company for the Utah Power & Light Company, a subsidiary of the Electric Bond & Share Company, the work being under the direction of the engineering department of the latter company.

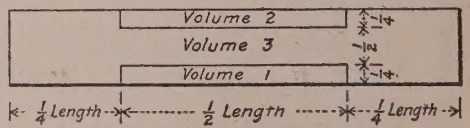
Specification for Fir Bridge Timbers Proposed

Rings Clause and Branding Suggested by Timber Committee of American Society for Testing Materials

FOLLOWING the step taken last year, when a Southern yellow-pine density specification was brought in, the American Society for Testing Materials at its recent annual meeting received from its timber committee a tentative specification for "selected structural Douglas fir" bridge and trestle timbers. The chief features of the specification are the provision of a ring clause for determining density and of a branding clause. The yellow-pine specification is followed in localizing the permissible defects in certain volumes. The specification will be printed among the tentative group and come up for final consideration with a view to adoption two years hence. Except for the omission of certain specifications, it is given here complete.

Dense and Sound Grades

Dense and Sound Douglas Fir—Under this heading two classes of timber are designated—(1) dense Douglas fir and (2) sound Douglas fir. It is understood that these two terms are descriptive of the quality of the clear wood.



VOLUMES FOR RESTRICTING DEFECTS

Dense Douglas Fir—Dense Douglas fir shall show on either one end or the other an average of at least 6 annual rings per inch or 18 rings in 3 in. and at least 33 1/3 per cent summerwood, as measured over the third, fourth and fifth inches on a radial line from the pith, for girders not exceeding 20 in. in height and for columns 16 in. square or less. For larger timbers the inspection shall be made over the central 3 in. on the longest radial line from the pith to the corner of the piece. Wide-ring material excluded by the foregoing will be accepted provided the amount of summerwood as above measured shall be at least 50 per cent.

In cases where timbers do not contain the pith, and it is impossible to locate it with any degree of accuracy, the same inspection shall be made over 3 in. on an approximate radial line beginning at the edge nearest the pith.

The radial line chosen shall be representative. In case of disagreement between purchaser and seller as to what is a representative radial line, the average summerwood and number of rings shall be the average of the two radial lines chosen.

Sound Douglas Fir—Sound Douglas fir shall include pieces of Douglas fir without any ring or summerwood requirement.

General Requirements

(*a*) The timber shall be only "dense Douglas fir."

(*b*) The timber shall be well manufactured, square edge and sawed standard size; solid and free from defects such as ring shakes and injurious diagonal grain, loose or rotten knots, knots in groups, decay, pitch pockets over 6 in. long or ⅜ in. wide, or other defects that will materially impair its strength.

(*c*) Occasional variation in sawing, not to exceed ¼ in. scant at the time of manufacture, will be allowed.

(*d*) When timbers 4 x 4 in. and larger are ordered sized, they shall be ½ in. less than rough size, either S1S1E or S4S, unless otherwise specified.

SPECIFIC REQUIREMENTS

Stringers, Girders and Deep Joists—The timber shall show not less than 85 per cent of heart on each of the four sides, measured across the sides anywhere in the length of the piece. It shall not have in volumes 1 and 2 (see drawing) knots greater in diameter than one-fourth the width of the face in which they occur with a maximum of 1½ in. in diameter. It shall not have in volume 3 (see drawing) knots larger than one-third the width of the face in which they occur, with a maximum of 3 in. in diameter. Knots within the center half of the span shall not exceed in the aggregate the width of the face in which they occur. Diagonal grain in volumes 1 or 2 with a slope greater than 1 in 20 will not be permitted. When stringers are of two-span length they shall be considered as two separate pieces and the foregoing restrictions applied to each half. The inspector shall place his stamp on the edge of the stringer to be placed "up" in service.

Caps and Sills—The timber shall show 85 per cent of heart on each of the four sides, measured across the sides anywhere in the length of the piece, and shall be free from knots larger than one-fourth the width of the face in which they occur, with a maximum of 3 in. in diameter. Knots shall not be in groups.

Posts—The timber shall show not less than 85 per cent of heart on each of the four sides, measured across the face anywhere in the length of the piece, and shall be free from knots larger than one-fourth the width of the face in which they occur, with a maximum of 3 in. in diameter. Knots shall not be in groups.

Longitudinal Struts or Girts—The timber shall show all heart on one face; the other face and two sides shall show not less than 85 per cent of heart, measured across the face or side anywhere in the length of the piece, and shall be free from knots over 2 in. in diameter.

Longitudinal X-Braces, Sash Braces and Sway Braces—The timber shall show not less than 85 per cent of heart on two faces and shall be free from knots larger than one-third the width of the face in which they occur, with a maximum of 2 in. in diameter.

Branding—The inspector shall brand each timber which conforms to the foregoing requirements "Selected Structural Douglas Fir."

The New Cement Specifications—The Changes Made and the Reasons Therefor

Explanation of the Requirements Which Are Expected to Receive General Approval and Become the Single Standard for This Country

By R. J. WIG

Member of the Joint Conference and A. S. T. M. Cement Committees, Washington, D. C.

THOSE who have not been closely identified with the preparation of the new specification for Portland cement, passed to letter ballot by the American Society for Testing Materials last week, may question the advisability of some of the changes and may desire an explanation of the committee's intent and purpose.

The writer, who has been intimately identified with this revision and is acquainted with the work of all the committees which gave it consideration, presents the following comments as his personal understanding of the committee's purpose.

Every requirement of the old specification has been changed in some respect and perhaps no other specification of the society has ever received such careful and thorough consideration.

HISTORY OF REVISION

There were two nationally recognized specifications for Portland cement in the United States in 1912—that of the American Society for Testing Materials, with methods of tests prepared by the American Society of Civil Engineers, and the United States Government specification.

At the suggestion of the cement committee of the American Society for Testing Materials a joint conference of nine members was organized, composed of three representatives from each interest—the government, the testing materials and the civil engineers' societies.

The Joint Conference convened in October, 1912, held numerous meetings and made various investigations. In April, 1915, it submitted its first report, which included a recommended uniform specification. This specification was given consideration by the cement committees of the U. S. Government and of the American Society for Testing Materials. The society's committee appointed numerous sub-committees that gave careful study to each recommendation of the conference, holding many meetings and making numerous investigations and tests.

The A. S. T. M. committee held a session of two days and two nights in April of this year, giving consideration to their subcommittee reports and also to the changes suggested by the government committee, which had held a meeting previously. As a result of this study, the cement committee of the A. S. T. M., on April 28, 1916, tentatively agreed upon a specification which modified in many particulars the specification recommended by the Joint Conference in its report of April, 1915.

This tentative specification of the A. S. T. M. was transmitted to the Joint Conference and the U. S. Government committee for further consideration.

On June 1, 1916, the Joint Conference issued its second report, including a revised uniform specification. This specification embodied many of the changes recommended by the A. S. T. M. and the government committees. On June 28, 1916, the A. S. T. M. committee considered this revised uniform specification and, with some few exceptions, approved it.

The cement manufacturers had no voice in the proceedings of any of the committees excepting that of the A. S. T. M. All changes made were agreed to by at least a majority of the engineers, representing consuming interests, upon the A. S. T. M. committee, excepting one item in the methods of tests—the tolerance clause on the fineness determination. The majority of the consumers desired to have this clause eliminated. With this exception the specification may be understood in one sense as a consumers' specification agreed to by the producers or manufacturing interests.

For the convenience of the reader, the old and new versions of each requirement will be given preceding the comment thereon. Additions or new matter is given in small type italics. Old matter omitted or changed is shown in small roman type.

DEFINITION

(Old) This term is applied to the finely pulverized product resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous and calcareous materials, and to which no addition greater than 3 per cent has been made subsequent to calcination.

(New) Portland cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion, an intimate and properly proportioned mixture of argillaceous and calcareous materials, with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum.

The old definition was considered to partake of the nature of a specification and to be improper in including quantitative chemical restrictions which were specifically provided for elsewhere. Furthermore, no test is available to the consumer whereby he may determine whether the 3-per cent limitation is exceeded. The limitations under "Chemical Properties" prevent adulteration and the use of gypsum in quantities considered to be deleterious.

CHEMICAL PROPERTIES

The cement shall not contain more than 1.75 per cent of anhydrous sulphuric acid (SO_3), nor more than 4 per cent of magnesia (MgO).

The following limits shall not be exceeded:

	Per Cent
Loss on ignition	4.00
Insoluble residue	0.85
Sulphuric anhydride (SO_3)	2.00
Magnesia (MgO)	5.00

A restriction on the insoluble residue was included in the specification in order to prevent adulteration of cement by the addition of raw siliceous materials or appreciable quantities of cement rock. This requirement has been in the U. S. Government specification for several years and has been found to be useful in rejecting adulterated cements. The maximum limit for sulphuric anhydride (SO_3) was increased from 1.75 to 2.00 per cent because there was no evidence that the quality of the material was impaired by such a change. The increase in the fineness requirement and further restriction in the time of setting made such a change desirable and logical from the standpoint of the manufacturer. This permissible increase will probably be taken advantage of only by a limited number of mills, for gypsum is more expensive than cement, and it is the desire of the manufacturer to restrict its use to a minimum. The maximum content of sulphuric anhydride fixed by European practice is as follows:

	Per Cent
England	2.75
Germany	2.50
Austria	2.50
Holland	2.50

The magnesia limitation was raised from 4 per cent to 5 per cent. All data available to the committees demonstrated that cements containing magnesia several per cent in excess of 5 per cent were equal in quality to those containing less than 4 per cent. The raising of this requirement reduces the cost of manufacture in some cases and should increase competition. This increase was first agreed to and recommended unanimously by the Joint Conference, upon which the cement manufacturers had no voice.

Specific Gravity

While the specific gravity requirement is still included, it was the general opinion that it furnishes little or no information. This requirement was said to be quite generally ignored in present practice. A cement meeting all other requirements was thought to be satisfactory irrespective of its specific gravity. While sufficient data were not available to warrant its complete elimination from the specification in the minds of some of the members, it is not made obligatory on the laboratory except when specifically ordered by the engineer. A lower specific gravity (3.07) is permitted for white Portland because by nature it has a very low iron content and correspondingly low specific gravity.

Fineness

It shall leave a residue of not more than 8 per cent on No. 100 and not more than 25 per cent on No. 200 sieve.

The residue on a standard No. 200 sieve shall not exceed 22 per cent by weight.

The increase in the fineness requirement is a recognition of the value of fine grinding. The engineers were not unanimously in favor of the change. Some were of the opinion that the improvement in quality might not be commensurate with the increased cost, while others doubted whether increased fineness improved all brands.

Tests made on a rather comprehensive scale showed an average increase of 2 per cent in the compressive strength of concrete at the age of one month for each 1 per cent increase in fineness between 25 and 15 per cent residue on the No. 200 sieve. The reader is cautioned against misinterpretation of this statement. Of two brands of cement one having a residue of 25 per cent and the other a residue of 20 per cent on the 200 sieve, the latter is not necessarily the superior in quality; the reverse may be true. The fineness of two cements alone does not furnish any indication of their relative cementing values in concrete. However, it is the belief of many members of the committees that every brand of cement is improved by finer grinding, provided no change is made in the composition and method of manufacture.

The increase in fineness was limited for the present to 22 per cent residue on the No. 200 sieve, as too great an increase at this time, it was believed, would unbalance many mills and work undue hardship on some manufacturers. Since approximately 40 per cent of the cement mills are at present grinding all their product to meet this requirement, its enforcement will not affect all mills alike. Many engineers look forward to further increases in fineness, provided future data continue to show their value.

The study of available data showed that the relative fineness of that portion of cement which is retained on the No. 100 sieve is unimportant, as it has little or no cementing value; and with present methods of grinding the great majority of cements meeting the present requirements of the No. 200 sieve will of necessity meet the requirements of the No. 100 sieve. Therefore the No. 100 sieve requirements have been omitted.

Soundness

Pats of neat cement about three inches in diameter, one-half inch thick at the center and tapering to a thin edge shall be kept in moist air for a period of 24 hours.

(a) A pat is then kept in air at normal temperature and observed at intervals for at least 28 days.

(b) Another pat is kept in water maintained as near 70 deg. Fahr. as practicable, and observed at intervals for at least 28 days.

(c) A third pat is exposed in any convenient way in an atmosphere of steam above boiling water, in a loosely closed vessel for 5 hours.

A pat of neat cement shall remain firm and hard and show no signs of distortion, cracking, checking or disintegration in the steam test for soundness.

It was the generally expressed experience of members that cements meeting the other requirements of the specifications never failed to meet the soundness requirement exposed in air or water, provided they remained sound when exposed to the steam test. All available data confirmed these statements. The air and water tests were therefore considered unnecessary and were omitted. The description of the test piece and method of making the test is included under "Methods of Tests," which forms an appendix to the specification.

Time of Setting

It shall not develop initial set in less than 30 min., and must develop hard set in not less than one hour nor more than 10 hours.

The cement shall not develop initial set in less than 45 min. when the Vicat needle is used or 60 min. when the Gillmore needle is used. Final set shall be attained within 10 hours.

While the old specification provided only for the use of the Vicat needle for determining time of setting, it was found that the majority of laboratories were using the Gillmore needles, because of their greater convenience. The new specification therefore provides for the use of either needle. Tests have shown that the Gillmore needle requires on the average about 15 min. more than the Vicat needle to indicate initial set. The increase in the time of initial set was deemed desirable by the engineers, as it is not uncommon to find that cements which meet the old specification requirements in the laboratory become quick setting on the work where the temperature is 10 deg. or more above that of the laboratory. This change was strongly recommended by a number of the engineers.

Tensile Strength

The minimum requirements for tensile strength for briquettes 1 sq. in. in cross-section shall be as follows, and the cement shall show no retrogression in strength within the periods specified:

NEAT CEMENT

Age	Strength, Lb.
24 hours in moist air	175
7 days (1 day in moist air, 6 days in water)	500
28 days (1 day in moist air, 27 days in water)	600

ONE PART CEMENT, THREE PARTS STANDARD OTTAWA SAND

Age	Strength, Lb.
7 days (1 day in moist air, 6 days in water)	200
28 days (1 day in moist air, 27 days in water)	275

The average tensile strength in pounds per square inch of not less than three standard mortar briquettes (see Par. 57) composed of one part cement to three parts standard sand, by weight, shall be equal to or higher than the following:

Age at Test, Days	*Storage of Test Pieces*	*Tensile Strength, Lb. Per Sq. In.*
7	*1 day in moist air, 6 days in water*	200
28	*1 day in moist air, 27 days in water*	300

The average tensile strength of standard mortar at 28 days shall be higher than the strength at 7 days.

The neat tests have been eliminated from the specification, it being the general opinion that they are unreliable and misleading. For example, the tests of cements ground to increased fineness showed decreased strength in the neat tests, although there were substantial increases in the mortar and concrete tests. It was not uncommon to find retrogression with age in neat tests between 7 and 28 days, although substantial increases were obtained in mortar tests.

The mortar strength requirements at 28 days were increased by 25 lb. per square inch. Tests substantiated by general experience showed that most cements gave strengths appreciably higher than the old-specification requirement. The new specification requires the use of 1 per cent more water in mixing the mortar, which gives greater uniformity in results, but on the average about 15 lb. lower strength. Therefore this is equivalent to further raising the tensile-strength requirement.

The retrogression clause was somewhat indefinite in the old specifications. In the new it is made specific as applying only to the 7 and 28-day periods. The committee gave consideration to compression tests as a substitute for the tension tests, but sufficient data were not available at present to permit its inclusion in the specification.

Inspection and Rejection

Every facility shall be provided by the contractor and a period of at least 12 days allowed for the inspection and necessary tests.

Cement failing to meet the 7-day requirements may be held awaiting the results of the 28-day tests before rejection.

All tests shall be made in accordance with the methods proposed by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers, presented to the society Jan. 21, 1903, amended Jan. 20, 1904, and Jan. 15, 1908, with all subsequent amendments thereto.

Every facility shall be provided the purchaser for careful sampling and inspection at either the mill or at the site of the work as may be specified. At least 10 days from the time of sampling shall be allowed for the completion of the 7-day tests and at least 31 days for the completion of the 28-day tests. The cement shall be tested in accordance with the methods hereinafter prescribed. The 28-day test shall be waived only when specifically ordered.

The old specification did not permit sufficient time to complete the 28-day tests, except in cases where the cement failed to meet the 7-day requirements. The new specification provides time for the completion of both tests. The committee's own methods are used rather than those recommended by the American Society of Civil Engineers. A clause is added covering the acceptance of cement upon a 7-day test when specifically ordered by the engineer. Many engineers objected to the inclusion of this clause, as it was felt that with the omission of the neat tests and many other tests in the specification the 28-day mortar tests should not be omitted except under very unusual conditions.

Practically no changes were made in the rejection clauses except in grouping them under one heading, changing the diction slightly and adding a new paragraph which provides for a tolerance on the allowance variation of weight of packages.

METHODS OF TESTS

In all previous specifications for cement the methods of tests were prepared by a special committee of the American Society of Civil Engineers. Therefore a consideration and revision of methods by the cement committee of the American Society for Testing Materials may be considered a departure from precedent.

Space will not permit detailed comments on the changes in the methods, which have been completely revised. Only the more important changes will be mentioned.

The old specification was remiss in not providing a detailed description of methods for sampling cement in packages and in bulk on board cars and at the mill. The new specification is more specific, but still leaves much to the discretion of the engineer.

In the determination of specific gravity and fineness, the apparatus used is of a standardized type and described more in detail than in the old specification. A clause is included on the fineness determination which states that "a determination tolerance of 1.0 is allowed and all results in excess of the specified limit, but within this tolerance, shall be reported as 22 per cent." While it is the opinion of the writer that this clause is a very desirable one from the standpoint of the testing engineer, and will avoid many disputes, the majority of the consumers on all committees were opposed to it.

The method of mixing paste and mortars, as well as the molding of test pieces for soundness, time of setting and tensile tests are described in more detail than heretofore. The percentage of water required for standard mortars is increased by 1 per cent.

GENERAL REMARKS

As a whole the new specifications may be considered a step in advance. As compared with the old specification it is simpler, unnecessary tests being largely eliminated. It is more stringent on the manufacturer in requiring greater fineness, slower initial setting time and higher tensile strength of mortars. It should be of assistance to the manufacturer by permitting the use of a greater quantity of gypsum to control setting properties and in some cases should reduce the cost of manufacture by permitting the use of stone of higher magnesia content.

The engineer, architect and general consumer should find material satisfaction in the new specification because it requires a better and more satisfactory product.

It is the writer's personal opinion, however, that while the new specification is superior to the old and will furnish a product equal or superior to that of any foreign specification, it is still far from satisfactory as a basis for the purchase of cementing material. It includes no tests whereby the engineer or consumer can obtain specific and reliable knowledge of the relative cementing value of two or more cements, and the methods for physical tests are still quite unreliable and subject to great improvement. With the continuation of the investigations now under way more important changes may be anticipated in the next few years.

Motor Truck Lessens Cost of Maintaining Gravel Roads in Alabama

Replaces from 16 to 20 Mules for Scarifying, Makes Complete Scraping Possible After Rains and Effects Material Saving in Gravel Hauling

By THOMAS H. EDWARDS
County Engineer, Montgomery County, Alabama

MONTGOMERY COUNTY, ALABAMA, has 650 miles of public roads, 450 miles of which are of gravel. In 1914, in order properly to maintain them, the County Board of Revenue decided to motorize the maintenance work. Material economies have been effected. One truck, it has been found, takes the place of from 16 to 20 mules for pulling a scarifier. The five trucks now in use make it possible to scrape practically the entire system after each rain, each truck pulling three road machines and being able to make 30 miles a day. A great saving has been accomplished in the hauling of the gravel. Four trailers are provided for each truck for this purpose.

SCARIFYING

The use of the motor truck has made scarifying a comparatively easy matter. As previously stated, where formerly from 16 to 20 mules were required to pull the scarifier, one of the trucks now accomplishes the work with ease.

Recently there has been completed 6 miles of scarifying and reshaping at a cost of $24 per mile. This includes rebinding. The writer understands that in a neighboring county a contractor bid as much as $400 per mile for similar work. The detailed costs are given in the accompanying table:

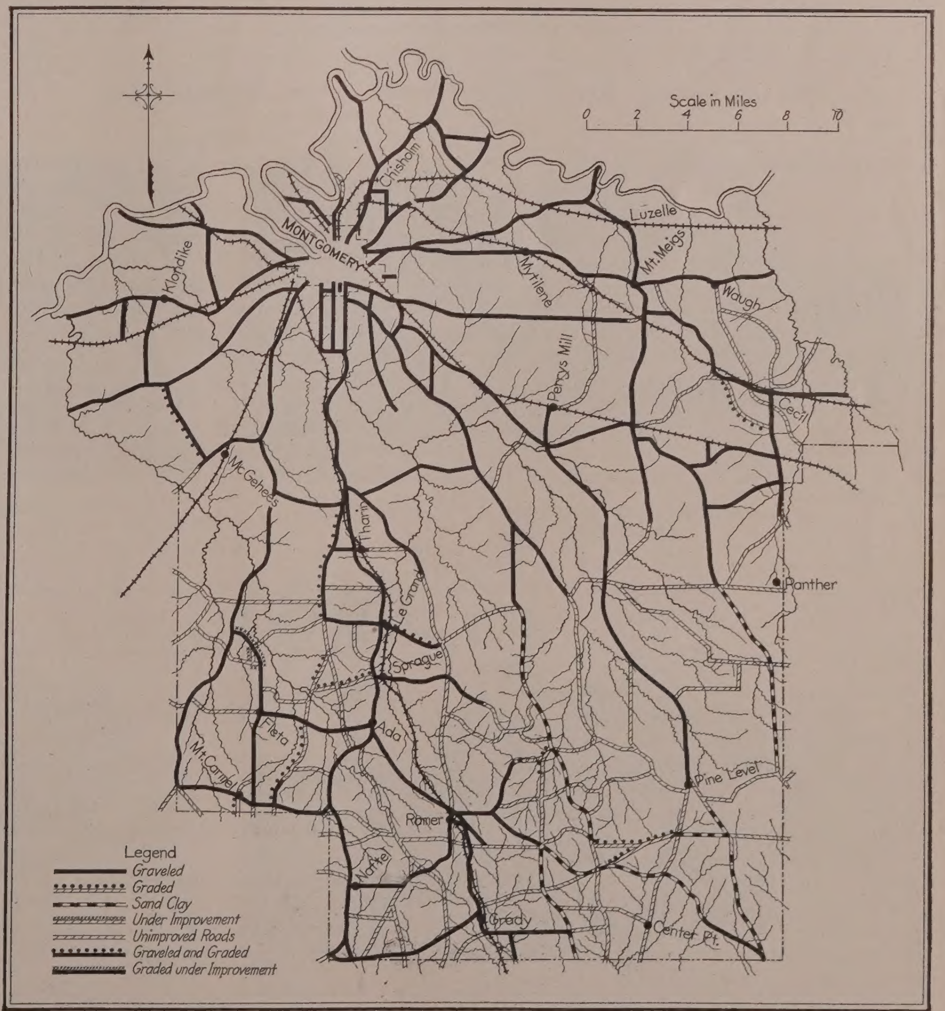
COSTS OF SCARIFYING 6-MILE ROAD

Gasoline for truck, 146 gal., at 25c	$36.50
Oil for truck, 35 gal, at 56c	19.60
Laborers' time, 31.5 days, at $1	31.50
Engineer's wages, 7 days, at $3	21.00
Foreman's wages, 7 days, at $3	21.00
Total cost of scarifying	$129.60
Cost per mile	21.60
Cost of shaping 6 miles with truck followed by road machine	14.78
Cost of shaping per mile	2.46
Total cost, per mile, of finished road	$24.06

It is very important, in the maintenance of gravel roads, to scrape them after each rain. With the five trucks now in use it is possible to cover practically the entire system before the roads become too dry to accomplish any good.

With the truck we are in position to completely scrape 30 miles of road per day. To do this there is hung to each truck a fleet of three road machines. A round trip completes the road.

The cost per mile of this class of work is about 50 cents. The cost for the 30 miles is: Driver, $3; foreman, $3; 3 la-



COUNTY'S SYSTEM HAS 650 MILES OF ROADS, 450 OF WHICH ARE OF GRAVEL borers, $3; gasoline, $5; oil, $1—a total of $15.

The replacing of chains, repairs to trucks, etc., necessary to truck upkeep cost about $400 per year.

HAULING GRAVEL

In connection with each truck there are four Troy reversible 3-yd. trailers. While the truck and two of the trailers are at the dump the other two trailers are being loaded. Therefore only about ten minutes are lost per trip, this being consumed in loading the truck.

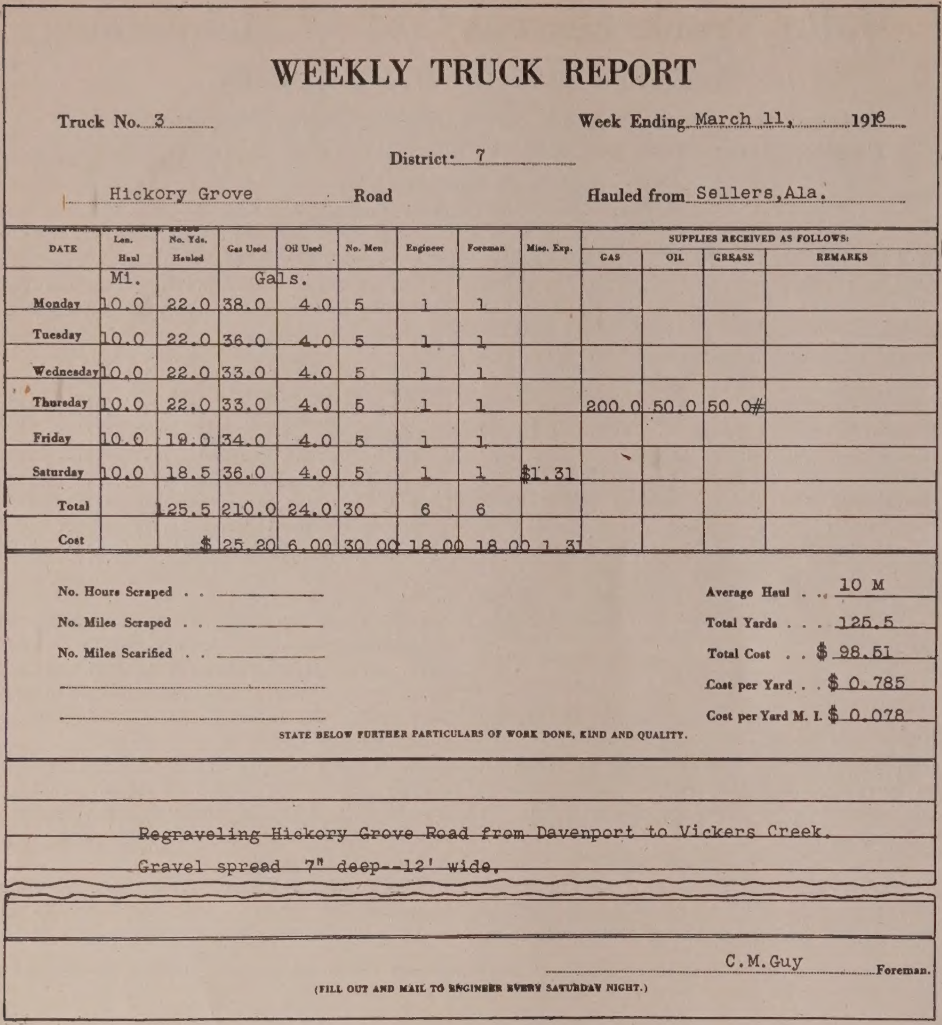
By this method of hauling, it has been possible to place gravel on the roads for from 7 to 11 cents per yard-mile, as against from 30 to 40 cents for mule haul, and includes spreading the material on the road.

With an increase of late in the price of gasoline from 11 to 25 cents per gallon it has been possible to keep the costs per yard-mile around 10 or 11 cents.

The accompanying table shows the unit costs of operating one of the trucks for hauling gravel during a week. The table shows a gasoline consumption of about 35 gal. per day. This is from 10 to 12 gal. more than the truck uses on the average haul, due to very long 12-per cent grades on the particular road traveled.

The first truck, a White 6-cylinder, latest type road truck, was purchased in the latter part of 1914. It proved such an economy to the county that four others were purchased, together with trailers and equipment. All of the trucks are of 5-ton capacity.

The Board of Revenue of Montgomery County is composed of the following members: R. H. Jones, president; H. M. Hobbie, J. T. Walker, J. L. Scogin and S. J. Guy. The work has been done under the supervision of the writer as county engineer.



WEEKLY TRUCK REPORT

Truck No. 3 Week Ending March 11, 1916

District: 7

Hickory Grove Road Hauled from Sellers, Ala.

DATE	Len. Haul	No. Yds. Hauled	Gas Used	Oil Used	No. Men	Engineer	Foreman	Misc. Exp.	SUPPLIES RECEIVED AS FOLLOWS:			
									GAS	OIL	GREASE	REMARKS
	Mi.		Gals.									
Monday	10.0	22.0	38.0	4.0	5	1	1					
Tuesday	10.0	22.0	36.0	4.0	5	1	1					
Wednesday	10.0	22.0	33.0	4.0	5	1	1					
Thursday	10.0	22.0	33.0	4.0	5	1	1		200.0	50.0	50.0#	
Friday	10.0	19.0	34.0	4.0	5	1	1					
Saturday	10.0	18.5	36.0	4.0	5	1	1	$1.31				
Total		125.5	210.0	24.0	30	6	6					
Cost		$	25.20	6.00	30.00	18.00	18.00	1.31				

No. Hours Scraped . . ______

No. Miles Scraped . . ______

No. Miles Scarified . . ______

Average Haul . . 10 M

Total Yards . . . 125.5

Total Cost . . $ 98.51

Cost per Yard . . $ 0.785

Cost per Yard M. I. $ 0.078

STATE BELOW FURTHER PARTICULARS OF WORK DONE, KIND AND QUALITY.

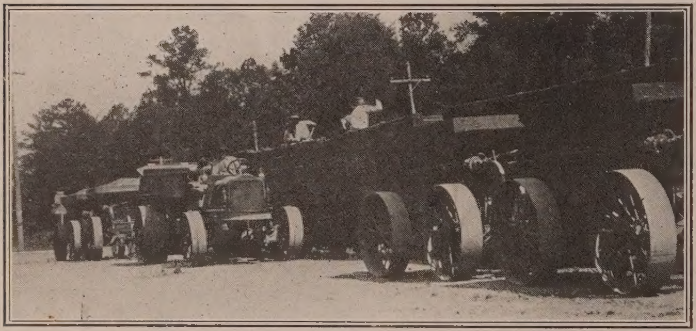
Regraveling Hickory Grove Road from Davenport to Vickers Creek.

Gravel spread 7" deep--12' wide.

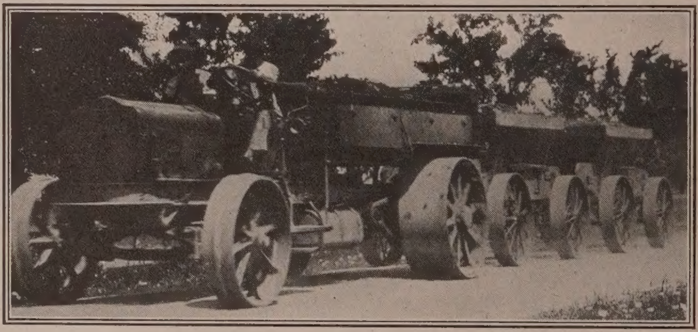
C.M.Guy Foreman.

(FILL OUT AND MAIL TO ENGINEER EVERY SATURDAY NIGHT.)

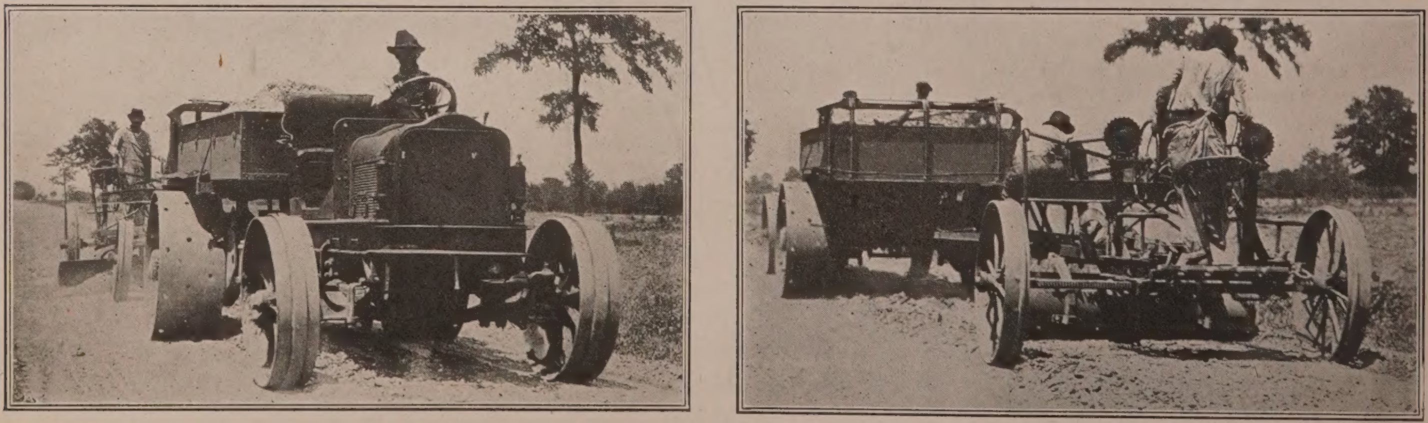
FOREMAN'S WEEKLY REPORT SHOWS DETAILED COSTS OF OPERATING TRUCK



EXTRA TRAILERS PROVIDED LESSEN TIME LOST IN LOADING MATERIAL



TRUCKS PULL TWO TRAILERS IN ADDITION TO CARRYING THEIR OWN LOADS



ONE TRUCK REPLACES 16 TO 20 MULES FOR PULLING ROAD MACHINERY AND COVERS 30 MILES A DAY

St. Paul Is Doing Intricate Track-Elevation Work in Chicago with Company Forces

North-Side Tracks Being Lifted for 3½ Miles on Narrow Right-of-Way Without Disrupting 4-Minute Schedule of Elevated Railway

ELEVATION of a steam railroad in a large city usually needs much maneuvering within narrow right-of-way limits to avoid interference with the frequent train service. It is not often, however, that it means upholding the schedule of a tenant elevated line, electrically operated, calling for trains on a 6-min. headway in each direction most of the day and on a 4-min. headway during the rush hours. This feat is being accomplished by the Chicago, Milwaukee & St. Paul Railway in Chicago, on the North Side line to Willamette, over which the Northwestern Elevated Railway operates. The present program of 3½ miles from Wilson Avenue, the junction with the Northwestern Elevated, to Howard Street and the city line is, like similar work of this company, being done by company forces. Features of the work are the careful timing of the operations to harmonize both with the daily fluctuations of traffic and with the various shifts in the running tracks, and the attempts to place each stick of timber and each shovelful of dirt where and so that it will do the most good with the least waste.

HEAVY TRAFFIC ON THE LINE

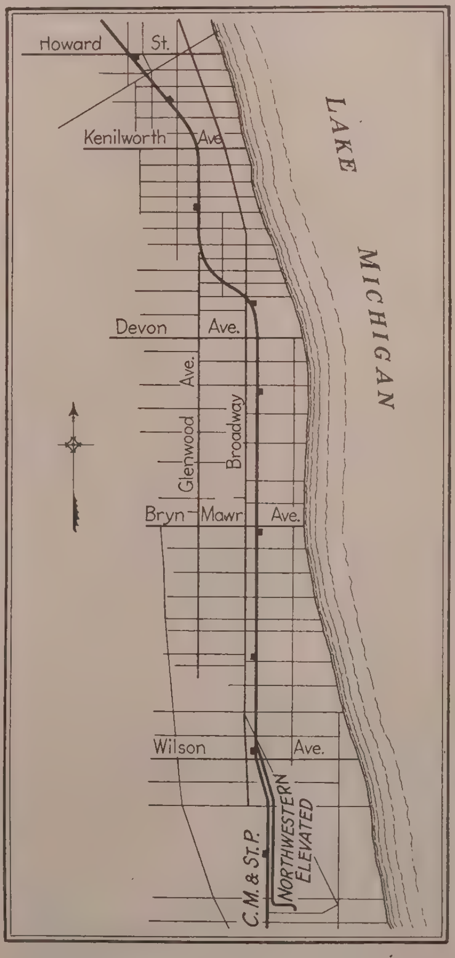
The work in question is on the Evanston branch of the Chicago, Milwaukee & St. Paul. This line, which prior to the beginning of this improvement was a three-track line, carries a twofold business—the comparatively light local freight business of the St. Paul and a heavy and rapidly increasing suburban travel on the Northwestern Elevated, which operates trains over the line from a junction at Wilson Avenue through Evanston to Willamette on a traffic agreement with the St. Paul. These trains run 6 min. apart each way during the greater part of the day and 4 min. apart during the morning and evening rush hours; and those familiar with the elevated "loop" in Chicago will realize that much interference with the schedule of any of its tributary lines would be disastrous to the entire elevated service. In addition to these trains it is of course necessary to move some material trains over the line, though the effort is made to do this mostly at night.

Before the track elevation was started the electric trains ran on the two east tracks, while the west track was used by the St. Paul for its freight business.

The present improvement is one of several, some of which have been completed, designed to elevate the entire line to the northerly limits of Evanston. The present program covers the work from the Wilson Avenue junction to the Evanston-Chicago city line at Howard Street. When the improvement is completed and the line fully developed there will be four tracks, two in the middle with island platforms for local trains and two on the outside for express service. The freight business will be handled on one of these latter tracks during the night, when no express trains are run.

The general program for prosecuting the work was determined largely by the fact that all the local industries with side-track facilities happened to be on the west side of the right-of-way. In order to keep these industrial facilities in commission the work has been prosecuted from the east side. Benefiting by the organization developed and the experience derived on the Bloomingdale Road work, which was described in the Engineering Record of Aug. 29, 1914, page 240, the work has been carried out by a regular sequence of operation, working in general from south to north. The sequence to the present time has been as follows: (1) Shifting of two main tracks to extreme west side of right-of-way, and retention of third as construction track; (2) excavation for east retaining wall; (3) placing of foundation for retaining wall; (4) carrying up of neat work; (5) replacing of construction tracks with pile trestle on line of second track from east side; (6) construction of east halves of abutments for bridges over streets; (7) filling from trestle, with material held by tie cribbing or by planks braced against the trestle until the fill was brought up high enough to support another track between trestle and wall; (8) laying of second track, and (9) shift of traffic from low to high level.

This shift was made in January, and the low-level tracks were released for construction purposes. The job will be finished by a similar sequence of operations: (1) Erection of second trestle, (2) completion of abutments and piers, (3) excavation for west retaining wall, (4) placing of wall foundations, (5) placing of neat work, (6) completion of fill from trestles, (7) removal of falsework under second and third tracks, and (8) laying of second and third tracks.



TRACK-ELEVATION PROGRAM COVERS 3½ MILES AND 35 STREETS, FROM WILSON AVENUE TO HOWARD STREET

SEQUENCES ALSO FOR SMALLER OPERATIONS

Not only has the work as a whole been carried out in regular sequence, but the individual operations have themselves been subdivided into sequences. For instance, in the construction of the trestle the pile driver went first, backing away to the north as the driving progressed, and the construction track was torn up at the same time. One gang sawed off the piles and capped them, another placed the stringers in position, another group of men followed with a pneumatic drill to make the bolt holes, another man followed dropping the bolts in place, and still others set the nuts.

In this way 132 piles were driven in one ten-hour day, and with a decking crew of fourteen men an average of 300 ft. of deck per day was placed. It was, in fact, necessary that the trestle crews do the work blocked out for them each day, because there was no room to store materials, and the day crews had each day to dispose of the materials brought in and spotted the night before by the work train. So restricted was the storage space and the opportunity to haul material by rail that considerable hauling from one part of the job to another was done by teams.

The material excavated for the retaining wall foundations was thrown under the construction track, which was jacked up as the work proceeded. The concreting was done from the special train with collapsible tower and dragline cableway described in the Engineering Record of June 21, 1913, page 701, and Nov. 15, 1913, page 544.

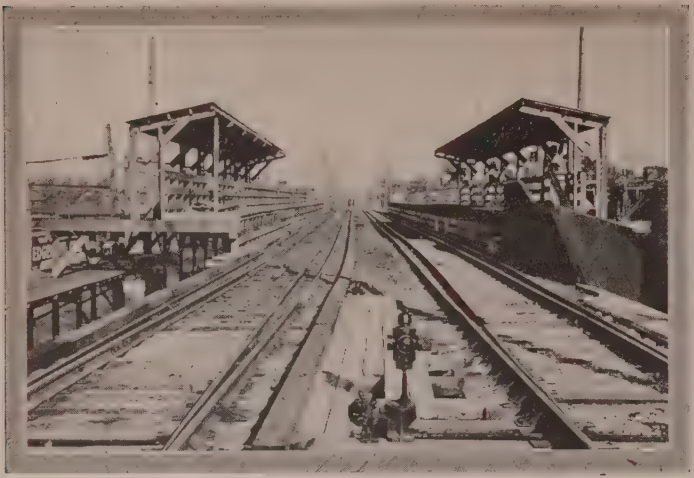
CHEAP CRIBBING

A decided saving over the use of tie cribbing to hold the fills under the trestle from the low-level tracks was accomplished by the use of planks braced against the trestle. The trestle was itself tied to the retaining wall by wires which connected to hooks set in the wall and passed around the tops of the nearest piles. The 3 x 12 planks were laid on edge one against the other against one of the center rows of piles on the far side from the wall and simply braced against other parts of the trestle clear of the fill, so that when it came time to remove them the props could be knocked out and the planks readily removed. The same planks will be used as bracing for the second trestle.

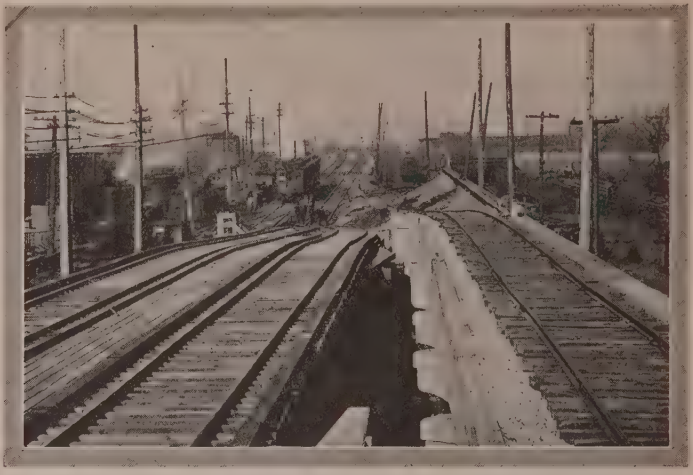
Another instance of the policy of putting timber to the maximum use is seen in one of the photographs, in the stringers carrying the tracks over the streets. These are 8 x 16 sticks unframed and skewed enough to lap.

SPECIAL PROBLEMS AT STATIONS

At the stations, of which there are eight on the work, there was not room enough to avoid tie cribbing, for the reason that the northbound track had to be swung east to make room for a 10-ft. island platform. The cribbing used here was not of the ordinary solid type, but was laid box-shaped and tied back to hooks in the retaining



HIGH-LEVEL SOUTHBOUND STATION IS CARRIED ON SAME COLUMN AS ROOF OF LOW-LEVEL STATION



SHARP DESCENT IS TEMPORARILY REQUIRED FROM EACH TRESTLE TO YARD NORTH OF HOWARD STREET

wall. The two forms of bracing are shown in the accompanying sketch.

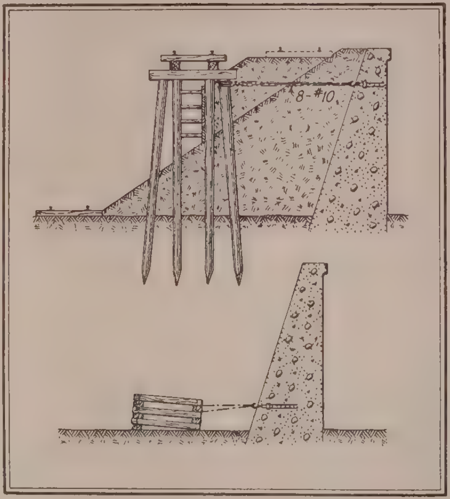
Before traffic could be shifted from the low to the high level it was necessary to provide station platforms at the high level. Outside platforms were built. On the east side an alley runs along the right-of-way for 2 miles, and at the stations it was necessary to span this alley with the platform supports, giving a clearance of 12 ft. On the west side the platforms are carried on long cross-beams spanning from the trestle to columns in the middle of the low-level island platform. When the second trestle is built the support of the west ends of the cross-beams will be transferred from the columns to the trestle. This platform is on the site of the permanent island platform of the ultimate arrangement.

One of the photographs shows clearly the construction at one of the stations. On the right is the east platform carried on the retaining wall and high columns beyond the alley. On the left is the southbound platform carried on cross-beams spanning the low-level northbound main, the roof of the low-level island platform appearing in the picture.

It will be noted that there is a gauntlet past each platform. This is necessitated by the fact that the elevated passenger cars are narrower than the freight cars, so that the former have to use the near tracks to come close enough to the platforms, while the latter have to use the far tracks to clear the platforms.

Another detail that had to be taken care of was the trolley wires. The trolley poles between the trestle and the low-level tracks adjacent were made high enough to support trolleys for either level. Ultimately it is expected to operate this line by third rail, and ducts for the cable lines have been built into the coping of the east retaining wall.

The line occupies Glenwood Avenue for six blocks, and here it was possible to throw the temporary low-level main tracks over into the east roadway, thereby clearing all of the masonry. This necessitated bridges on sharp skews at the curves at each end to carry the high-level trestle over these low-level tracks, and it has also necessitated humping the trestle above the final profile in order to secure the necessary clearance at the crossings. Run-around trestles were built from the low-level trestle. One of the photographs shows one of the crossings in the back ground, with the high-level trestle humped up, and the low-level run-around trestle in course of construction.

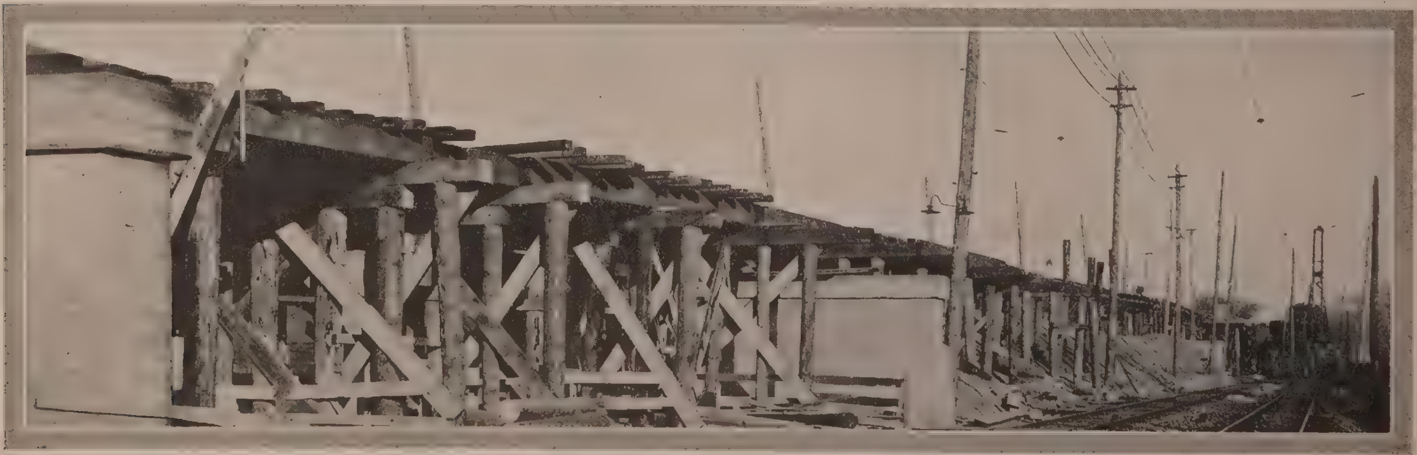


TWO METHODS FOR HOLDING FILL AWAY FROM LOW-LEVEL TRACKS

QUICK SHIFT AT HOWARD STREET

At Howard Street, the most northerly station on the work, a special problem had to be met. Here one or two cars are cut from northbound trains and either put on southbound trains or switched into a yard just north of the station. Vice versa, cars are brought from this yard and attached to southbound trains. This yard is, of course, on the low level, and when the shift was made from the low-level to the high-level tracks it was necessary to make the entire shift of switches and crossovers in one day, between morning and evening rush hours. The entire change was accomplished in five hours. The switches and yards are shown at the bottom of the steep incline in the background of one of the photographs.

The retaining walls on this work are of the so-called semi-reinforced and cellular type used by this company. The bridges are of reinforced concrete throughout, with the exception of one or two where the sharp skews and long spans necessitated steel fascia girders. In these cases the girders will be incased in concrete. The intermediate supports are arched bents on rectangular columns. They are of standardized shapes and are cast in steel forms. The



THIS FORM OF TEMPORARY STREET CROSSING IS TYPICAL—NOTE HUMP CROSSING AND LOW RUN-AROUND TRESTLE IN BACKGROUND slabs are cast in place by constructing falsework in the struts to support the forms.

As previously pointed out, the absence of storage space and the impossibility of hauling materials in during the day necessitated the careful development of a system for getting the materials to the job. The company has a large yard at Galewood, and each afternoon a train of materials to be used next day is made up and hauled to Chicago, arriving there in the early evening. After midnight the cars are hauled to the work and spotted to be unloaded the next day. At the same time the empty cars are removed, so that there is little or no switching on the main tracks during the day. As an extra precaution double crossovers connect the main tracks every ¾ mile or so, so that if it becomes necessary a short section of either track can be cut out of service.

The entire improvement is being done by company forces, which have numbered as high as 1200. The work was started two years ago, but was suspended shortly afterward for a period of nine months. It is being carried out under the direction of the engineering department of the Chicago, Milwaukee & St. Paul Railway, of which C. F. Loweth is chief engineer, A. G. Holt, assistant chief engineer, and H. C. Lothholz, engineer of design. C. H. Buford, assistant engineer, is in immediate charge, with F. C. Loweth and J. E. Weston as assistant engineers.

Urges Education of Public to Need of Health Laws

Many Sanitary Statutes Poorly Drawn, Unnecessarily Severe and Inconsistent As Between Various Communities and States

THAT a health department should educate its public to a law before attempting to introduce it and that the nonobservance of sanitary laws is due in a large measure to their defects were contentions made by Paul Hansen, chief engineer of the Illinois State Board of Health, in the discussion following George A. Johnson's paper on the typhoid toll, presented (abstracted in the Engineering Record of June 17, page 803) at the American Waterworks Association convention, held in New York City recently. These notes are taken from Mr. Hansen's discussion.

FULL-TIME HEALTH OFFICER NEEDED

Most sanitarians have a very clear idea of how an effective local health department should be organized, paid and conducted, but they also realize that it is out of the question to secure the right kind of a health organization at once. It has been the universal experience in health activities that the only manner in which results can be obtained is to concentrate on one thing at a time. The all-important step to take at the present time is to secure the employment of the full-time health officer. He will, of course, not entirely solve the problem of health administration, but he will carry it a long way in the right direction. Once he is recognized as a necessary institution those interested in the promotion of health can work for the elaboration of the health department's organization.

The nonobservance of sanitary laws is due in a large measure to the fact that many of them are poorly drawn, unnecessarily severe, inconsistent as between various communities and states, and often far in advance of what the public will stand for. Attention should be given to the modification of sanitary laws so that there may be greater uniformity of practice. In connection with certain state sanitary laws relating to the activities of engineering bureaus a tendency exists to make such laws altogether too lengthy, too drastic and to include in them too much of the unessential. Too much stress cannot be laid upon the necessity of drawing up sanitary legislation with great care, so that it will be practically enforcible and will not exceed what will have the backing of public opinion. In other words, the health department should educate its public to the need of the law before attempting to introduce it.

WORK TANGIBLY GUARANTEED

Exception is taken to the proposition of Mr. Johnson that state boards of health should not be given power to review plans for the installation of water supplies, water purification plants, sewerage systems and sewage treatment works, but should be required to approve any scheme for water purification, and, presumably, waterworks, sewerage systems and treatment works that is tangibly guaranteed. In the first place, engineers who design works of this character are not in the habit of guaranteeing that their designs will work properly, nor are clients in the habit of demanding such guarantees. In fact, it would be in general considered unprofessional.

It would seem, then, that the guarantee must be made on the part of the contractor. This would be unfair when the contractor is bidding upon an engineer's detailed plans, and in most classes of sanitary engineering work it is necessary for the engineer to prepare his plans in detail. An occasional exception to this is current practice in connection with the installation of water-purification works.

CONTRACTORS' GUARANTEES

Engineers frequently draw their specifications so that the filter contractors can bid on their own plans and specifications for a part or the whole of the work; but as this is not universal practice, and as water-purification works represent only one class of engineering works that must be reviewed by the state boards of health, Mr. Johnson's proposal would not be practicable.

Furthermore, allowing that it would be possible in every case to secure tangible guarantees, every engineer knows that such guarantees are often not worth the paper they are written on. In no field has this been more evident than in the water-purification field, for, as is well known, a poorly-designed, crudely-constructed filter plant can be made to furnish pure water during trial tests under skillful manipulation, though similar results cannot be expected under ordinary operating conditions.

A proper check on possible mischief on the part of the state boards of health which do not have competent engineering advice is to have the law so framed that any municipality, corporation or institution which has occasion to submit plans to it, and which may not regard the requirements of the board as correct or just, may demand a reference of the matter to a commission of expert sanitary engineers, to be appointed and employed jointly by the state board of health and the party taking exception to the board's orders. Such a plan has been adopted in the State of Ohio, and has worked well to the extent of its applicability.

Recommends Extra Right-of-Way at Sharp Curves

H. E. Bilger Declares That Public Travel on Highway Will Be Benefited Out of All Proportion to Additional Expense

THE IMPORTANCE of a clear view on sharp turns in the alignment of a highway at cross-roads and railroad crossings, of lengthening the curve radius and of ample passing room and practically level approaches at railroad crossings was emphasized by H. E. Bilger, road engineer of the Illinois State Highway Department, in a paper presented at the Conference in Highway Engineering at Kansas State Agricultural College, held at Manhattan, Kan., March 4.

OLD ALIGNMENT NOT ADEQUATE FOR PRESENT TRAFFIC CONDITIONS

The alignment that, 15 years ago, satisfactorily met the requirements of a maximum speed of 8 or 10 miles per hour cannot suffice, with any reasonable degree of safety, for the present traffic conditions that impose a speed of from 20 to 40 miles per hour upon the highway. The present conditions are such as make imperative that, in all highway improvements, this matter be given serious consideration, and in view of the increasing density of the high-speed traffic it becomes advisable that due attention be paid to probable future traffic developments.

Without in any way interfering with the economics of highway location, there can be effected, even in the details of the work, a marked improvement in the general comfort and safety of the traveling public. For example, at all abrupt angles in the right-of-way, and particularly those approaching 90 deg., an improvement can be brought about by simply procuring the necessary additional right-of-way to permit moving the inner fence corner a distance of some 75 ft. or more. By so doing the radius of the curve can be considerably lengthened and a much better view provided, to the end that public travel is benefited out of all proportion to the cost of the little triangle of land. In order that this additional right-of-way at the corner may be utilized to the utmost, it is necessary that all vegetation be kept down and that the signboards, if any, be transferred elsewhere.

ADDITIONAL LAND AT CROSS-ROADS

At all cross-roads additional land should be provided by moving the fences back to include within the limits of the right-of-way the four triangles at the corners. This greatly enhances the view in all directions by bringing the control of the corners within the authority of the road officials, thereby arresting the growth of vegetation that obstructs the view of highway travel.

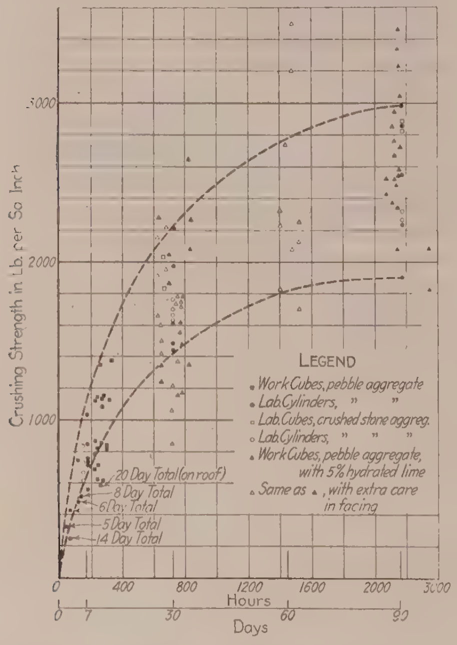
In the vicinity of railroad crossings the improvement of the highway should be such as to provide an unobstructed view along the track for at least 1000 ft. each way. This view should be enjoyed along a length of the highway extending for at least 300 ft. on each side of the crossing. At the crossings it is particularly important that sufficient accommodations be provided to permit two vehicles to pass with entire comfort and safety, requiring never less than 18 ft., and the highway for some 50 ft. or more on each side should be practically level, or should at least have a very easy grade, say not steeper than about 2 per cent.

Test Concrete Cured Under Freezing Conditions

Time for Removal of Forms in Philadelphia Electric Power House Determined by Tests of Specimens Poured on the Work

POURING of the floor slabs between steel beams in the Philadelphia Electric Power House, described in the Engineering Record of Feb. 19, page 340, had to be continued during the cold winter weather. While no concrete was poured during freezing weather, the temperature was frequently much below freezing for a long period after pouring. In fact there were times when the water froze in icicles below the slabs on the day after pouring.

Although the materials were all heated before pouring (steam coils being used for the sand and gravel), so that the concrete probably had some time to set before reaching the freezing temperature, it was desired to make certain that the strength was sufficient before removing the forms. For this purpose a schedule was prepared for the various parts of the work, with greater time requirements as the length of span increased. This schedule was made by counting only the hours that the concrete had cured above a temperature of 32 deg.



COMPRESSION TESTS OF CONCRETE SHOW EFFECTS OF FREEZING TEMPERATURES

Test Cubes Poured on Work

In addition 6-in. test cubes were poured from the concrete going into the floor and exposed to the same temperature conditions as the slab they represented. These cubes were tested in the laboratory, and if the strength exceeded 800 to 1000 lb. per square inch the forms could be removed, provided there was not too much evidence of frost in the structure, and provided the floor was not loaded with material or by shores from above.

The accompanying diagram shows the results of tests of both laboratory and field specimens. For the latter the results are plotted in terms of number of hours above 32 deg., the actual age being noted only in a few special cases. For example, one cube 14 days old, but with only 60 hr. above 32 deg., failed at 250 lb. per square inch, and one cube 20 days old, almost half of that time at a temperature below freezing, failed at a unit load less than 600 lb. In general the results plotted on this basis of time above 32 deg. fall within the approximate curves drawn on the diagram for limits found by testing the standard laboratory cylinders kept at a temperature of 70 deg. In comparing results, however, it should be noted that cubes should give higher results than the standard cylinders. Furthermore the cubes cast on the work had the advantage of the beneficial effect of the heating of the materials and of machine mixing.

Tests of Large Aggregate

The comparison between the strength of 1:2:4 concrete made of pebbles and similar concrete made of crushed stone shows no consistent advantage either way, although the cylinders made with pebbles gave slightly better results. This was probably due to the fact that these pebbles were almost pure quartz, with some of granular quartz formation and some of dense sandstone.

The test results for the specimens cast on the work in which 5 per cent of hydrated lime had been used are seen to be variable, no noticeable effects on strength being obtained. It was thought that a careful bedding of the ends of the test cylinders in the testing machine might produce better results, but, as the plotted points show, there seems to be no definite advantage.

It may be inferred from these test results that a satisfactory and reliable method of estimating the strength of concrete cured under freezing conditions is to consider the age to be the same as the number of hours of temperature above 32 deg., or preferably above 35 deg. Fahr. Thus, knowing the approximate strength, it is possible to determine when it is safe to remove the forms.

What Is the Relation Between Yield Point and Proportional Limit for Steel?

Discussion Before A. S. T. M. Considers Definitions and Indicates Sources of Variation—Wide Disagreement Regarding Terms

FACTORS affecting the relation between yield point and proportional limit in various grades of steel were discussed by several members of the American Society for Testing Materials at the recent meeting in Atlantic City, June 27 to 30. In addition to the preprinted discussions, three written communications were presented. The effects of composition and heat treatment on the relation in question, and the relative value and meaning of elastic limit and yield point, are vital points in the discussion. Whether yield point or elastic limit should be used by the designing engineer and whether commercial testing methods accurately determine the desired quantities were also considered. Of the discussions abstracted herewith those of J. E. Howard and of H. F. Moore and F. B. Seely were printed in advance of the meeting.

Discussion by H. F. Moore and F. B. Seely

The views of H. F. Moore, assistant professor of mechanics, University of Illinois, and F. B. Seely are best given by the following quotation from their printed discussion:

"An examination of test data from various sources, actual experience with apparatus for measuring deformation and a study of the literature of the subject have led the writers to believe that no absolute limit of elasticity has been determined for any actual material, and that for materials used in engineering practice Hooke's law is an approximation—an extremely close approximation for structural materials, but still an approximation rather than a rigidly exact statement of facts. Any limit of elasticity, however determined, is regarded as a practical criterion for static elastic strength, rather than as the limit of absolutely elastic action for the material. For purposes of definition for testing engineers such a limit should be fixed at a stress for which some very small, but definite, deviation from elastic action is detected.

"The stress at which a very small but definite permanent set can be detected is probably the most nearly logical 'elastic limit,' but the process of determining such a limit is very slow, and this limit has never been recommended as suitable for commercial testing. The yield point is at present the commonest limit used in practice. The proportion limit (of stress to deformation) promises to be the most generally useful of all the proposed limits of elastic strength, if some method of determination of the proportional limit can be recognized as standard—a method which shall yield consistent results, and which shall not be too complicated nor too slow for use in commercial testing laboratories.

"Recently the writers have begun a series of tests to determine by various methods the variation of the value determined for the proportional limit, and also the variation in value determined which is caused by unevenness of gripping of test specimens. . . .

"Evenness of stress distribution is probably never completely attained even with threaded-end specimens and spherical-seated holders. With such a gripping device very carefully adjusted, appreciable variation was observed in the stresses along three gage lines. Lack of alignment of upper and lower gripping devices is only one of the possible causes of unevenness of stress distribution. Another important cause lies in the transmission of the stress from the gripping device to the specimen, unevenness in bearing of threads in a threaded-end specimen, unevenness of hold of wedge grips, etc.

"Values of the proportional limit determined from a single gage line may be far from representative for the material. The values of the proportional limit for test specimens with threaded ends and spherical-seated holders do not differ greatly from the values found with wedge grips in good alignment. This would indicate that considerable variation in evenness of gripping may take place without greatly affecting the value of the proportional limit determined."

J. E. Howard, engineer-physicist, Interstate Commerce Commission, Washington, D. C., whose discussion, like the preceding ones, was printed in advance, pointed out that the modulus of elasticity is the fundamental feature on which it is convenient to judge of the elastic limit of steel. With a constant value for this modulus, any departure of the stress-strain curve from a straight line signifies the introduction of a permanent set and establishes the value of the elastic limit. The behavior of steel is generally such that the elastic limits and proportional limits coincide; nevertheless, it would not be inconsistent with the meaning which might attach to the latter expression were the extensions or compressions of the metal to include both elastic strains and progressive permanent sets. A restricted meaning should properly be placed on the term "proportional limit" to exclude permanent sets, without which it presents no barrier against the presence of permanent sets of any degree of magnitude.

The Term "Yield Point" Held to Be Vague and Uncertain

The influence of time, in respect to rapidity of loading, he continued, has no practical effect on the display of elastic extensions. The strains which are displayed by the steel correspond to the stresses, however rapid the applications or alternations of loads may be. This has been shown in the case of repeated alternate stresses, and there is no reason for doubting the same to be true for direct loads of tension or compression. The conditions attending ordinary testing, however, are such that very rapid extensions are difficult to follow. This limitation pertains to the testing apparatus rather than to the behavior of the metal.

The term "yield point" does not appear to have any fixed meaning, and in his opinion there seems to be no feature in the behavior of steel which calls for the use of this term, or to which it could properly apply. The term is essentially vague and uncertain, and well calculated to create confusion. It is an approximation to the elastic limit, but having been given a name it purports to have a definite meaning. The most that can be said about it is that a structural member loaded up to its yield point will suffer a certain amount of permanent strain.

He did not discuss the relation between yield point and proportional limit because, he stated, one of these terms is vague and without definite meaning, while the other is held to be synonymous with the expression "elastic limit," which he regards as preferable.

Discussion by R. P. Devries, Assistant Physicist, Bureau of Standards

R. P. Devries, assistant physicist, U. S. Bureau of Standards, Washington, D. C., directed his discussion to a consideration of Mr. Howard's views. He said, in part:

"The statement by J. E. Howard, in considering the effect of speed of testing, that the strains which are displayed by the steel correspond to the stresses, however rapid the application or alternation of loads may be, is important, if true. Reversal tests have been made [to which references were given] giving the conclusion that resistance in metals varies more or less in proportion to the rapidity of the reversals; other tests give opposite conclusions, and others in which no relation was found if the alternations do not exceed 2000 per minute. Mr. Howard's published tests do not seem to have reached this speed, and it is evident that the strains must lag because of hysteresis.

"It would be better not to define yield point at all if the following statement by Mr. Howard is correct: 'The most that can be said about it is that a structural member loaded up to its yield point will suffer a certain amount of permanent strain.' However, when yield point as defined by Committee E1 is considered, engineers do not view this matter in the same way. If certain structural steel should show no yield point, it would be of more than theoretical interest to the structural engineer. At the proportional or elastic limit, steel no longer follows the straight-line law but extends according to another more complex law. Important changes are recognized, including distinct slipping of the crystal grains, and the yield point may mark the ending of some state of flow. The yield point is not more artificial than the critical points in the slow cooling of steel."

Theoretical Discussion by G. R. Olshausen

G. R. Olshausen, engineer physicist of the U. S. Bureau of Standards, discussed the matter from the theoretical point of view. The question, he said, whether there is any difference in the magnitude of the elastic limit and the proportional limit, and under what conditions this difference occurs, may be treated by assuming the total deformation as composed of two parts—elastic strain and nonelastic or permanent strain. Thus

$$L = L_e + L_s$$

in which L is the total deformation, L_e is the elastic elongation and L_s is the permanent set. The existence of either or both of the defined limits depends on the manner in which these deformations vary with the stress S. From the definition of the elastic limit, L_s must equal zero, and from the definition of the proportional limit L must equal kS below these limits respectively. (Nine different cases are distinguished in a table not reproduced here.)

It is improbable that the case for the proportional limit greater than the elastic limit ever occurs, and the most important case is where the two limits are equal, which is the only case where both limits exist. Both terms, however, should be retained in order to indicate in what manner the determination was made.

H. S. Morse Would Abandon Term "Elastic Limit"

Major H. S. Morse, of the Watertown Arsenal, believed that the printed discussion was far from settling the serious confusion of ideas among engineers and manufacturers. He submitted the following definite suggestions: (1) That the term "elastic limit" be as far as possible abandoned as having lost its definite meaning through abuse, and that the term "proportional limit" be habitually substituted therefor; (2) that the proportional limit should be required as a portion of the acceptance test for all materials which are to be used in parts designed with low or moderate factors of safety, and (3) that the proportional limit be habitually determined by plotting a sufficient number of points and drawing a graph, the proportional limit being located where Hooke's law line intersects a second straight line drawn to the curve which represents the yield point of the metal.

Harrowing Highly Important in Gravel Roads

H. E. Bilger, of Illinois State Highway Commission, Describes Construction of Gravel Roads by Feather-Edge Method

IN CONSTRUCTING gravel roads, either in one or two courses, the importance of thorough harrowing can scarcely be overestimated, for to secure the best results it is essential that the voids in the gravel be reduced to a minimum. This point was strongly emphasized and other suggestions for gravel road construction by the feather-edge method were given by H. E. Bilger, road engineer of the Illinois State Highway Department, in a paper presented some time ago at the Conference in Highway Engineering, at the Kansas State Agricultural College, Manhattan, Kan.

Roadbed Preparation

Before any gravel is hauled onto the road its cross-section should be brought to the requirements of the plans and the entire width of the graded roadway should be thoroughly rolled until it is practically of a uniform density at all places. The portion that is to form the subgrade for the gravel should be dry, compact, almost perfectly smooth and should have such cross slope as may be necessary to shed readily any surface water that might fall thereon. The rolling should be done preferably with a three-wheel self-propelling roller weighing from 300 to 400 lb. per inch of width of tread on one rear wheel. If such a roller is not readily available, a tractor of similar design and having approximately the same weight will usually answer the purpose.

The purpose of the rolling is quite as much to detect the location of soft and yielding spots as it is to consolidate the roadbed generally. When these spots are detected additional material should be added until the yielding ceases.

Placing the Gravel

The work of placing the gravel might begin at either end of the road, but it should be carried on continuously to the other end.

During the process of construction, and before any particular section of the road is completed, the gravel might be subjected to the traffic of the vehicles used in further construction. Should such traffic rut or displace the gravel, it should be reshaped and rerolled before further work is done.

When the bonding material in the gravel is not entirely satisfactory with respect to both quality and quantity, it is usually advisable that two-course construction be adopted.

It is important that some positive and accurate method of determining the volume of gravel delivered upon the roadbed be used. Upon completion of the roadbed temporary side forms having a width equal to the depth of the loose gravel should be set on it, true to line and grade. These should be held in place by stakes at such intervals as will prevent lateral deflection greater than about 3 in. from the true alignment. Whether the gravel is to be hauled by wagons, motor trucks, industrial railways or other vehicles, it might be dumped directly upon the subgrade. After a sufficient quantity has been placed for the lower half of the road, it should be distributed to a uniform depth by the use of a blade-grader, drag scraper or otherwise.

While this course is being spread, all the larger stones should be raked or otherwise placed directly in contact with the subgrade.

Such an amount of bonding clay as may be necessary in order that the gravel will comply with the specifications should be placed on the lower course gravel, and, after it has been spread, should be thoroughly harrowed several times over until the cores formed by dumping have been entirely loosened up to a density equal to that in the other portions. The importance of this thorough harrowing can scarcely be overestimated, for in order to secure the best results it is essential that the voids in the gravel be reduced to a minimum, which means that a maximum density of material must be obtained. This density is closely approached by harrowing until the pebbles of the several sizes become so placed as to occupy the spaces between those of a large size. The cost of the harrowing, as compared with the results obtained, is practically negligible, and if necessary it would actually be more advisable to do away with the rolling and retain the harrowing than vice versa.

HARROW SHOULD BE OF STIFF-TOOTH TYPE

The harrow should be of the stiff-tooth type, and should have metal teeth at least an inch in diameter extending about 6 in. below the frame. The spacing of the teeth should be such as will admit of the free passage of the stones between them, and yet so displace the gravel as to produce the density desired. The design of the harrow should provide a weight of from 8 to 12 lb. upon each tooth.

After the second course of gravel has been placed it should be spread until its upper surface comes flush with the top of the side forms and its cross-section conforms to that shown on the plans for loose gravel. The forms should then be removed and the gravel allowed to take its natural position. Upon the second course there should be distributed the necessary quantity of bonding clay in the same manner as in the case of the first course.

Should the gravel, with its natural or artificial mixture of bonding clay for the upper 4 in. of road, be of such a character that it will not insure a satisfactory wearing surface with a dense body and uniform texture, an inch coating of bonding gravel should be applied uniformly over the entire surface. This should be raked and rolled in until all the interstices are filled and the surface is smooth, of a uniform texture and free from waves.

ONE-COURSE CONSTRUCTION

When the conditions and materials are reasonably suitable, there can be built with one-course construction a gravel road that will in all respects prove as satisfactory as one built by the two-course process.

If the gravel contains naturally a sufficient quantity of satisfactory bonding material, one-course construction will generally prove the more economical.

When so employed the gravel may be dumped upon the roadbed and spread with a blade grader, drag scraper, hand rakes or otherwise until the material at the edges comes flush with the temporary forms. The forms should then be removed and the gravel thoroughly harrowed several times over until the cores formed by dumping the gravel have been entirely loosened up and the upper 4 in. has a uniform density.

Sewage-Testing Station Report Limits Processes

Cleveland Report States That Grit Drops at 30 to 60 Feet Per Minute and That Roughing Filters Will Not Work

IN THE report of the sewage-testing station in Cleveland definite answers are given to proper grit-chamber velocities, sedimentation-detention periods, washing methods for roughing filter, "greenhouse" sludge treatment, and disinfection. Most of the work was completed two years ago, but the report has just been made public. Its recommendations bearing on the solution of the sewage-treatment problem were commented on in the Engineering Record of May 13, page 631.

With but few exceptions the Cleveland sewers are of the combined type. Experiments were carried out on the easterly interceptor receiving 50 per cent of the 100,000,000 gal. received during dry weather. This sewage is mainly of domestic origin, containing an average of 250 parts per million of solid matter in suspension. The long travel resulted in a stale sewage. The following conclusions are stated:

It is possible to secure the grit in a condition which is inoffensive, nonputrescible and readily adapted for use as a filling material. Such a grit contains on the average not more than 15 per cent of volatile matter and has a specific gravity of 1.6. With an average detention period of 50 sec., during dry-weather flows there is deposited approximately 0.6 cu. yd. of grit per 1,000,000 gal. of flow, and during storm flows approximately 0.7 cu. yd. per 1,000,000 gal. of flow. Velocities ranging from 30 to 60 ft. per minute produce a grit of the proper character.

A mechanically operated screen was tested with wire fabric of 50, 80 and 120 nominal meshes per linear inch. With all three sizes the loss of head through the screen, the flow per unit area of screening surface, the clogging difficulties and the percentage removal of suspended matter were approximately constant. This indicates that the 50-mesh is as fine as it is desirable to use.

Based upon the suspended-matter determination, the average removal by the mechanically operated screen was 20 per cent; and based upon the amount of screenings produced, this removal was 25 per cent. The latter figure is undoubtedly a more exact measure of the work actually accomplished by the screen. The screen removed the larger particles of solid matter which ordinarily, by reason of floating material or sludge banks, form objectionable conditions at submerged outlets.

SCREENINGS A NUISANCE

From the standpoint of operation the most serious phase of the screening problem is the disposition of the screenings. About 650 lb. of dry material were produced per 1,000,000 gal. of sewage treated; and while the screenings drained quickly, they soon became offensive. At treatment sites located near residential districts there would have to be provided, in a screening plant, some means whereby the screenings could be disposed of without creating a nuisance.

The results obtained with the plain sedimentation tanks during the winter months were fairly good, but with the advent of warm weather it became impossible to secure satisfactory results. Active ebullition started after only a small amount of sludge had accumulated, and this greatly decreased the removal efficiency of the tanks. During the warmer part of the year it would be necessary to desludge the tanks every ten days or two weeks. On account of the nuisances in treating undigested sludge this process would be objectionable in residential districts.

In the operation of the septic tanks results similar to those obtained with the plain sedimentation tanks were secured. The characteristic tank scum never became permanently established, and the tanks decreased in efficiency as the age of the run increased.

The vertical-flow, or Dortmund, tank was operated for only a portion of two months. In view of the production of odors and the foul character of the effluent, this short period of operation was sufficient to eliminate from further consideration tanks of this type.

IMHOFF TANKS WORKED

The most consistent results were obtained from the operation of the Imhoff tanks. An average suspended-matter removal of 50 per cent was secured. Dissolved oxygen was present at those times when it was present in the crude sewage. The iron removal was low on account of the flocculent condition in which it was present in the sewage, and this undoubtedly decreased the removal efficiency of these tanks. In general it may be said that a detention period of 30 min. accomplished a removal of suspended matter from 40 to 45 per cent, as compared with a 50-per cent removal effected by a detention period as long as 2 hours and 15 minutes.

The roughing filters, when operated at rates ranging from 30 to 60 gal. per acre per 24 hours, removed from 25 to 40 per cent of the suspended matter in the applied sewage. The action of these filters was simply mechanical, there being no increase in the dissolved oxygen content, due to treatment. The difficulties encountered in their operation were sufficient to eliminate this process, either as a method in itself or in combination with other processes. Chief among the operation difficulties were the satisfactory treatment of the wash water and the disposal of the sludge deposited upon the surface of the filters.

The sludge investigations were made with digested sludge which was black, homogeneous, full of minute gas bubbles, and non-offensive. Only a slight tarry odor could be detected when drying beds were flooded with this sludge, and then this odor was restricted to the immediate vicinity of the beds.

A large number of analyses were made, special attention being given to the possible fertilizing constituents of the sludge. The average moisture content was about 87 per cent. Computed on a dry basis the volatile matter was 35 to 38 per cent; nitrogen, about 1.5 per cent; ether soluble matter, 6 to 14 per cent; phosphates, as P_2O_5, between 1 and 1.5 per cent; and potash, 0.3 per cent. In comparison with garbage tankage produced at the municipal garbage reduction plant, for which there is a ready market, the sewage sludge contains about one-half as much nitrogen and one-third as much phosphates. The ether soluble matter is mostly composed of light hydrocarbon oils, the presence of which might be detrimental in a fertilizer. If extracted it would be of too poor quality for use in the manufacture of soaps; but it is not possible to say that no market could be found for this byproduct which would pay for the cost of its extraction.

Drying sludge on open sand beds gave results which depended upon the weather. During the summer months it was found possible to reduce the moisture content of the sludge to a spadable condition in seven days. These results were obtained under favorable conditions of temperature and dry weather. On the other hand, sludge applied to the open beds in October was not in a condition for removal until late in the following spring. It will probably be possible to operate beds of this type so that 1 sq. ft. of surface will dry 0.4 cu. yd. of sludge per year. The foregoing statement applies when the original sludge has a moisture content of approximately 87 per cent and the removed product 70 per cent.

DRY SLUDGE UNDER COVER

In order to obtain in sludge drying an independence from weather conditions a covered sludge bed was built, modeled after standard greenhouse construction. This type of bed can be operated throughout the entire year, provided a heating system is installed to prevent freezing during the winter months. During the summer months the period of drying is approximately the same as, or possibly a little longer than, with the open beds. Eliminating the three winter months of operation, it is possible to operate beds of this type so that 1 sq. ft. of surface will dry 0.8 cu. yd. of sludge per year.

Two types of filter presses were tested, one being operated by a high air pressure from without the filter cloth and the other by a vacuum acting on the inside of the filter cloth. The high-pressure press afforded a clean and nonoffensive method for reducing the moisture content of sludge. Reductions as low as 60 per cent were obtained with pressures between 30 and 35 lb. per square inch. During the drying period it was at times found a little better to increase the pressure to 50 lb. per square inch. This high-pressure press was of a size used in actual practice.

In order to remove the danger of pollution from disease germs at the bathing beaches along the lake front, a disinfectant must be applied to the treated sewage effluents. The tests indicate that from 5 to 7 parts per million of available chlorine will effect a bacterial removal of from 85 to 90 per cent.

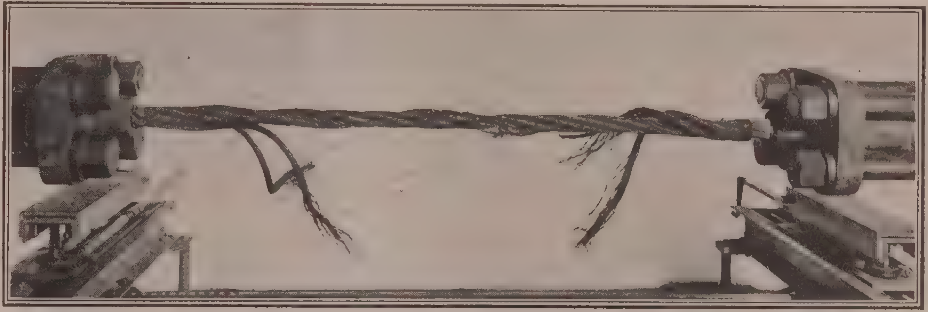
The work was carried out under the direction of R. Winthrop Pratt, consulting sanitary engineer, reporting to Robert Hoffman, Commissioner of Public Service. Harry B. Hommon, chemist, had direct charge of the testing station.

Heavy Wire Rope Tested at Bureau of Standards

New Sockets and Grip Pieces Have Been Designed to Develop the Full Capacity of Emery Testing Machine at Washington

WIRE ROPES of unusual size, for use at the Panama Canal, were submitted to the U. S. Bureau of Standards for testing, and the results for six specimens recently tested show ultimate strength values varying from 184,000 to 215,000 lb. per sq. in. of net area for 2-in. and 2¾-in. plow-steel hoisting rope respectively. The total ultimate loads varied from 293,000 lb. for 2-in. rope to 937,000 lb. for 3¼-in. rope. The details of the results of these tests and the composition of the specimens are given in Tables 1 and 2.

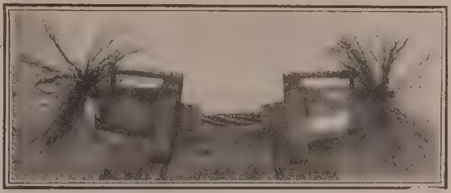
There is also presented herewith a detailed description of the new cable holders, or sockets, designed to develop the full capacity (1,200,000 lb.) of the Emery testing machine at Washington, including the methods used in preparing the specimens. Ordinarily, rope-testing is carried on at the Pittsburgh branch of the bureau, but steel cable of greater strength than 600,000 lb. exceeds the capacity of the machine in that laboratory. It was therefore thought advisable to provide the large Emery machine at Washington with cable holders for a wide range of heavier testing. John A. Roebling's Sons Company supplied these holders in accordance with the design furnished by the bureau.


APPEARANCE OF 12-FT. PLOW-STEEL-WIRE ROPE AFTER TEST

DETAILS OF SOCKET

This holder or "socket" differs from those in commercial use chiefly by its greater size. A nut is threaded to fit the end of the grip piece, and occupies the space usually taken in the jaws by the serrated portion of the grips. The holder was designed to carry a load up to the full capacity of the machine (about 1,200,000 lb. in tension), and every part of the holder, with the probable exception of the bowl proper, will be stressed nearly up to the proportional limit by such a load.

The small projecting cone frustum shown at the left of the side elevation of the socket bowl is a convenience for centering the rope, and is provided with suitable bushings for specimens of various sizes.


WIRES BROOMED AND WASHED BEFORE SPELTER IS CAST AROUND THEM

PLACING SPECIMEN IN MACHINE

For placing a specimen in the machine the procedure is as follows: The socket bowls, attached to the rope ends by heavy zinc castings filling their conical bowls, are laid longitudinally between the machine heads, their rectangular flanges resting on two adjustable trestles. A strut inserted below the rope counteracts the turning moment of the bowl and some 125 lb. of spelter in each. The grip pieces, with end nuts attached, are inserted in the grips. The stirrups are fitted astride the semicircular saddles of the grip pieces and their threaded ends passed through the corner holes of the sockets and secured by nuts. The initial load is then applied and the strut removed.

FASTENING CABLES IN SOCKETS

The process of fastening cables of large size in the sockets offers some difficulties, and the following practice has been adopted:

The cable is wrapped with fine wire at the ends and also at points about 15 in. from

TABLE 2—RESULTS OF CHEMICAL ANALYSES OF WIRE ROPES

Rope No.	Ultimate strength, lb.	Composition, per cent Carbon	Sulphur	Phosphorus	Manganese	Silicon
1	866,000	0.58	0.032	0.033	0.41	0.160
3	550,000	0.68	0.030	0.016	0.58	0.130
4	937,000	0.82	0.025	0.019	0.23	0.169
5	304,000	0.90	0.034	0.024	0.48	0.172
6	694,000	0.77	0.036	0.027	0.46	0.152

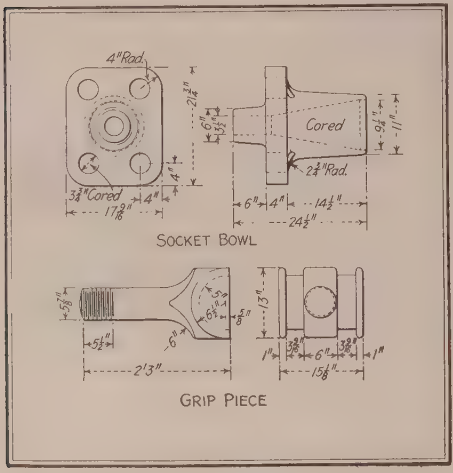
Chemical analysis for No. 2 was not made. Qualitative tests for vanadium and nickel on No. 4 gave negative results.

TABLE 1—SUMMARY OF PHYSICAL TESTS ON WIRE ROPES AT NATIONAL BUREAU OF STANDARDS

Rope No.	Diameter-in.	Material	Number of strands: Large	Number of strands: Small	Wires in large strands: No.	Wires in large strands: Diameter, in.	Wires in small strands: No.	Wires in small strands: Diameter, in.	Total area of wires, sq. in.	First crack heard at, lb.	Ultimate strength, lb.	Ultimate strength, lb. per sq. in. of net area	Character of failure
1	3¼	Plow steel..	6	6	25 6 6	0.1540 0.1695 0.1285	9 10	0.0550 0.0935	4.61	735,000	866,000	187,900	Two strands broke in the middle
2	2	Plow steel..	6	0	19 6	0.1285 0.0520	0		1.55	280,000	293,000	189,000	One strand broke in the middle
3	2¾	Not stated..	6	0	19 6	0.1890 0.0760	0		3.36	540,000	550,000	163,400	One strand broke in the middle
4	3¼	Monitor plow steel	6	6	42 6 6 7	0.1160 0.1360 0.0995 0.1285	7 6 6	0.0860 0.0820 0.0670	4.63	720,000	937,000	202,400	One strand failed near one end
5	2	Plow steel..	6	0	19	0.1360	0		1.65	255,000	304,000	184,200	One strand failed near, but not in, the socket
6	2¾	Plow steel..	6	0	19 6	0.1850 0.0760	0		3.23	645,000	694,000	214,900	One strand failed about 1 ft. from each end

the ends. The socket bowls are then slipped on and placed, temporarily, well toward the middle of the specimen. The end windings are now removed and the wires "broomed" as uniformly as possible down to the 15-in. wrappings, as shown in one of the photographs. The iron bar seen attached to each socket is a removable lug for convenience in handling by crane. Each wire is carefully scrubbed with gasoline. The sockets are then placed at their proper positions and fixed there by means of two 4 x 4-in. pine struts placed at opposite sides and two tie rods placed at diagonally different corners of the flange plates. The proper bushings are driven in when necessary and the whole system up-ended. A platform is built up to a convenient working level and the washing process continued by spraying the "broom" with 50-per cent hydrochloric acid. The acid runs out past the bushing and is followed by a spray of rinsing water.

The spaces between strands and bowl are now carefully packed and sealed with fire-clay and the whole reinforced with burlap. The crucible of molten spelter is next hoisted. On account of the moisture remaining in the socket, the stream is poured small at first and is gradually increased in volume until the wires have been incased to a length roughly equal to five times the diameter of the whole cable. It is usually feasible to make the castings at both ends on the same day, though, of course, sufficient time must be allowed the first casting for hardening before the ends are reversed. No trouble has been experienced with any slippage or failure at or in the sockets.



SOCKET BOWL AND GRIP PIECE DETAILS

The oxyacetylene flame is now being used to cut wire-rope specimens to a standard test length of 8½ ft., leaving about 4½ ft. exposed between the holders. After the conclusion of tests the failed cable is cut away at the sockets by the same means and the spelter plugs forced out in a 1,000,000-lb. Riehle hydraulic compression machine. One of the photographs shows a 12-ft. specimen after test.

Water Supplies in West Virginia Are Being Improved

During the last four months the division of sanitary engineering of the department of health of West Virginia has built one new sewage-disposal plant and placed three new water supplies under construction. Nine water supplies have installed liquid-chlorine apparatus. Five more supplies soon to be developed will use the chlorine treatment.

Special Details Are Used in Design of Steel Elevated Structures in Brooklyn

Beveled Sole Plates on All Stringers Decrease Bending at the Seats on Cross-Girders—Field Riveting Reduced in Detailing Curved-Bracket Connections

SEVERAL unusual and effective details have been developed in the design of the new steel elevated structures in Brooklyn now under construction as the part of the dual contracts being built by the New York Municipal Railway Corporation to be operated by the Brooklyn Rapid Transit Company. Section 1 of the Jamaica line, which is temporarily a two-track structure, with provision for a future third track, is now nearly completed, and the details for section 2, here described, represent the practice which has been followed from the beginning of the new construction, with a few minor modifications which have developed during the progress of the work.

Beveled sole plates on the longitudinal girders effectively decrease the bending induced at the seats on the cross-girders. These seats are detailed to support the total end shear in case the rivets in the end connection angles should work loose or drop out. Crimped lateral plates and wide gages for the end-connection rivets are used to minimize this danger. Other unusual details consist in the use of plate supports for the ties over the cross-girders and in the details for field riveting of the connections of the curved brackets.

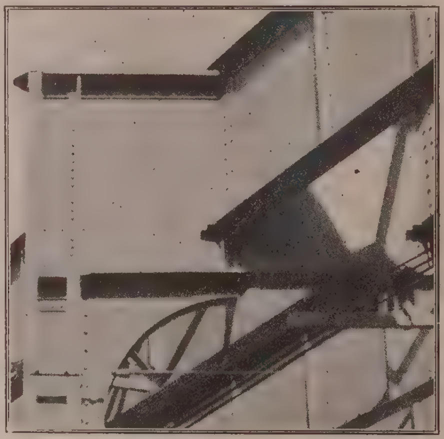
The live load specified for each track of the Brooklyn elevated steel structures consists of a train of 60-ton cars with equal axle loads of 30,000 lb. spaced 5, 30 and 5 ft. apart, with 10 ft. between the adjacent axles of two cars. Station platforms and floors are designed for a live load of 80 lb. per square foot. Impact is added to the stresses from the electric cars by the following formula:

$$I = \frac{L^2}{2\,(L + D)}$$

in which I is the impact stress, L is the maximum live load of stress of the same kind as the dead-load stress, and D is the dead-load stress. If the live-load stress is of the opposite kind, the impact is taken as one-half of the live-load stress, D in the formula being assumed equal to zero. A lateral force of 450 lb. per linear foot of one track is specified, assumed to act at the top of the stringers. Traction force is specified as 10 per cent of the weight of a 500-ft. train assumed distributed over 1000 ft. of length if the track is on a tangent.

STRUTS FROM FLANGES OF LONGITUDINAL GIRDERS STAY TOPS OF COLUMNS

The allowable unit stresses conform closely to the American Railway Engineering Association standard specifications, with 16,000 lb. per square inch as the base unit stress.



CABLES SUPPORTED BELOW GIRDER FLANGES—NEW SLING DETAIL SEEN AT END OF CROSS-GIRDER

End Details of Longitudinal Girders

To avoid the difficulties with loose rivets frequently experienced at the connections between the longitudinal girders and the cross-girders, seats are shop-riveted to the cross-girders to support both the fixed and the expansion ends. These seats are strong enough to carry the total loads from the stringers in case the rivets in the main connection to the web plates should become loose and have to be replaced by bolts. The main connection to the web is also sufficient to carry the loads, so that double strength is provided. Before these connection rivets in the fixed ends are driven, the stringers are fastened down to the seats. In addition, the main connection is made by wide gages in the 5-in. legs of the connection angles, to give more elastic play and decrease the tendency to loosen these rivets.

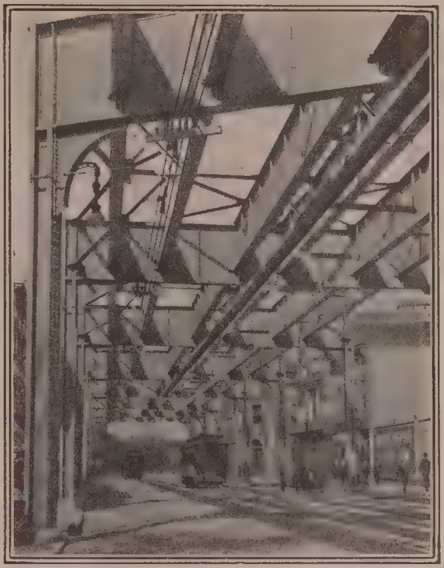
An unusual and effective detail is the beveled sole plates on all stringers, designed to decrease the bending at the cross-girders by confining the stringer load to 1 in. nearest the web of the cross-girder. The expansion joints occur about every 200 ft. At these points the bending moment is resisted by the small longitudinal brackets to the adjacent fixed stringer, as shown. The counter-sinking of the rivets connecting sole plates to girders is now avoided at the fixed ends by making the plates 7 in. long instead of 6 in., as used in earlier designs.

At the fixed-end connection between

stringers and cross-girders the top lateral plate is crimped, as noted on the drawing, in order to allow elastic deformation and prevent excessive stress in the rivets connecting to the cross-girders. This plate connects the under side of the top flange angle of the stringer with the top of the flange cover plate of the cross-girders, after being crimped.

Another unusual detail is seen in the tie-supporting plates on the cross-girders. As the ties are subject to constant renewal, it was desired to make the trackwork absolutely independent of the steel by providing a continuous steel surface to support the ties, which are not dapped, and thus allow the placing of the hook bolts at any desired position. The minimum distance of 1¾ in. specified from the top of the stringers and of the supporting plates for the ties to the top of the cross-girder is the least possible to accommodate the hook bolts under the plates.

The small plate at the end of the cross-girder, with a shelf angle support, is the latest detail devised for the purpose of carrying the telephone cables which pass along the structure. A small S-hook attached to the plate carries wire slings which support the cables.

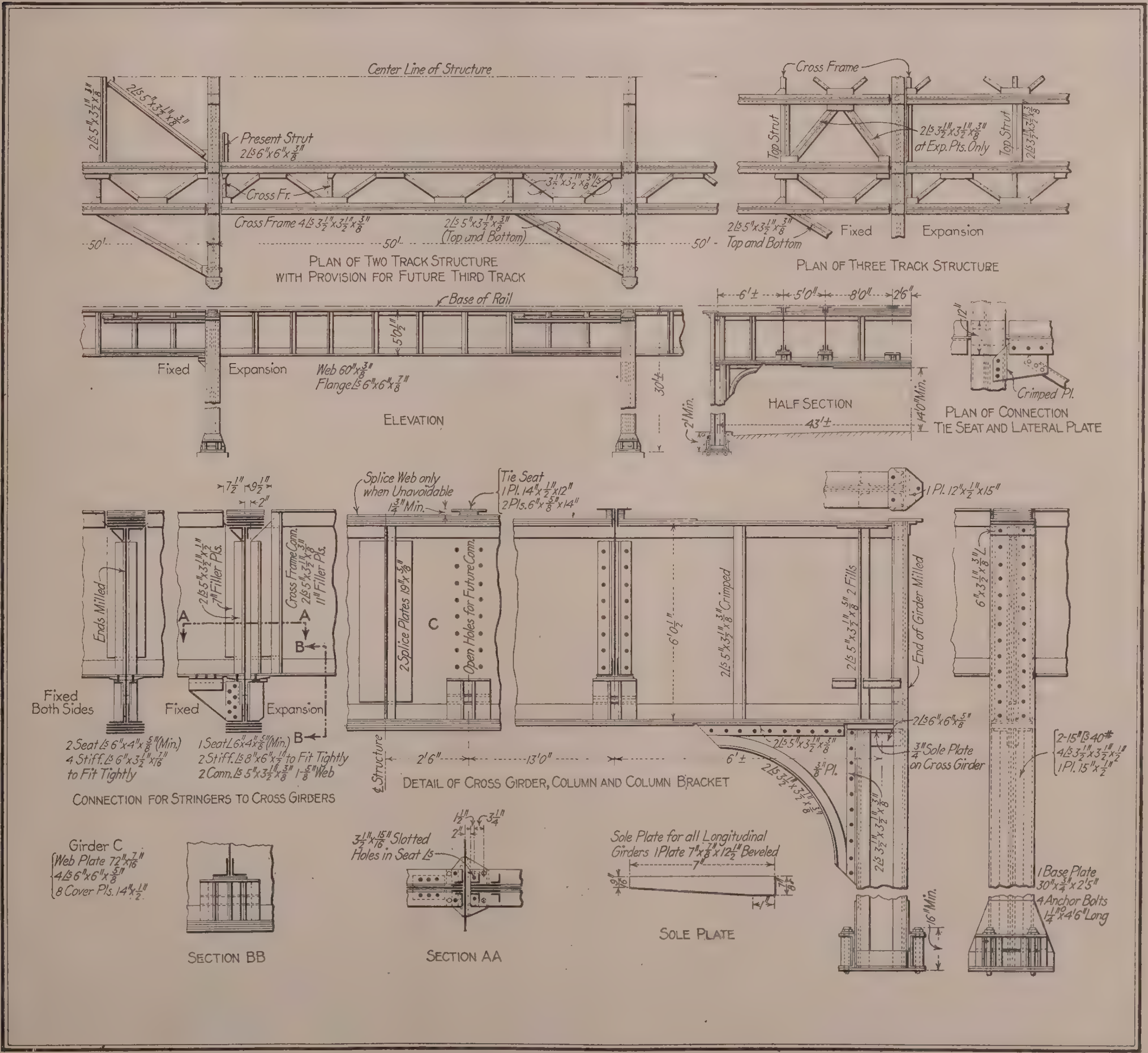


THREE-TRACK STRUCTURE IN JAMAICA, BOROUGH OF QUEENS, FOR EXTENSION OF BROOKLYN ELEVATED RAILWAY

BRACKETS FIELD-RIVETED TO CONNECTION ANGLES

In order to decrease the number of field rivets to be driven between the curved brackets and the cross-girders and columns, which of course are duplicated hundreds of times in such a structure, the brackets are not shop-riveted with the connection angles, but the latter are shipped riveted to cross-girders and columns. In this way, only one row of rivets instead of two in each case is driven in the field. The brackets are first connected to the columns, and the cross-girders then erected by slipping the angles on the latter over the web of the brackets. The vertical-bracket connection angles are faced with the main-column section, and thus take direct bearing from the sole plate on the cross-girder.

Owing to the tonnage on this work, it has been possible to avoid nearly all web-plate splices in the girders, even though the lengths of plates exceed the usual limit fur-


Center Line of Structure
2 ∠s 5"x3½"x⅜"
2 ∠s 5"x3½"x⅜"
Present Strut 2 ∠s 6"x6"x⅜"
Cross Fr.
3½"x3½"x⅜" ∠s
Cross Frame 4 ∠s 3½"x3½"x⅜"
2 ∠s 5"x3½"x⅜" (Top and Bottom)
50'
50'
50'
PLAN OF TWO TRACK STRUCTURE WITH PROVISION FOR FUTURE THIRD TRACK
Cross Frame
Top Strut
2 ∠s 3½"x3½"x⅜" at Exp. Pts. Only
Top Strut
2 ∠s 3½"x3½"x⅜"
2 ∠s 5"x3½"x⅜" Top and Bottom
Fixed
Expansion
PLAN OF THREE TRACK STRUCTURE
Base of Rail
5'0½"
Fixed
Expansion
Web 60"x⅜"
Flange ∠s 6"x6"x⅞"
30'±
ELEVATION
6'±
5'0"
8'0"
2'6"
2' Min.
HALF SECTION
43'±
14'0" Min.
12"
Crimped Pl.
PLAN OF CONNECTION TIE SEAT AND LATERAL PLATE
7½"
9½"
2"
Ends Milled
2 ∠s 5"x3½"x½" 7" Filler Pls.
Cross Frame Conn. 2 ∠s 5"x3½"x⅜" 11" Filler Pls.
A
A
B
B
Fixed Both Sides
Fixed
Expansion
2 Seat ∠s 6"x4"x⅝" (Min.) 4 Stiff. ∠s 6"x3½"x7/16" to Fit Tightly
1 Seat ∠ 6"x4"x⅝" (Min.) 2 Stiff. ∠s 8"x6"x½" to Fit Tightly 2 Conn. ∠s 5"x3½"x⅜" 1-⅝" Web
CONNECTION FOR STRINGERS TO CROSS GIRDERS
Splice Web only when Unavoidable
1¾" Min.
Tie Seat 1 Pl. 14"x½"x12" 2 Pls. 6"x⅝"x14"
2 Splice Plates 19"x⅝"
C
Open Holes for Future Conn.
6'0½"
2 ∠s 5"x3½"x⅜" Crimped
2 ∠s 5"x3½"x⅝" 2 Fills
End of Girder Milled
1 Pl. 12"x½"x15"
6"x3½"x⅜" ∠
2 ∠s 6"x6"x⅝"
2 ∠s 5"x3½"x⅜"
¾" Sole Plate on Cross Girder
⅜" Pl.
2 ∠s 3½"x3½"x⅜"
2 ∠s 3½"x3½"x⅜"
2-15" [s 40#
4 ∠s 3½"x3½"x½"
1 Pl. 15"x½"
℄ Structure
2'6"
13'0"
6'±
DETAIL OF CROSS GIRDER, COLUMN AND COLUMN BRACKET
Girder C
Web Plate 72"x7/16"
4 ∠s 6"x6"x⅝"
8 Cover Pls. 14"x½"
SECTION BB
1½"
3¼"
2"
3½"x15/16" Slotted Holes in Seat ∠s
SECTION AA
Sole Plate for all Longitudinal Girders 1 Plate 7"x⅞"x12½" Beveled
7"
SOLE PLATE
16" Min.
1 Base Plate 30"x¾"x2'5"
4 Anchor Bolts 1¼"x4'6" Long

TYPICAL DETAILS OF NEW BROOKLYN ELEVATED CONSTRUCTION—COLUMNS AT CURB nished by the mills. Where webs are spliced, the splice is made strong enough to develop the bending resistance of the web plate, as this bending is counted in designing the flange section of all girders.

DESIGN OF COLUMNS

The column design is made flexible by the use of two channels and a built-up I-section, as shown. The difficulty with rolled I-beams owing to nonparallel flanges, mentioned in the article in the Engineering Record of July 17, 1915, page 76, on the Queens extension of the New York elevated, and the fact that nothing larger than ¾-in. rivets could be used in the flanges of these 15-in. I-beams, led to the adoption of this type very early in the work on the Brooklyn lines.

By using stiff struts from the top and bottom of the longitudinal girders to the columns, as shown in the plan view, it was considered permissible to regard the columns as being fixed at both ends in computing the bending effects of the tractive force, as well as the bending caused by lateral forces and wind pressure. The extreme fiber stress produced by the bending from either of the foregoing causes combined with the direct dead and live load stress was not allowed to exceed the regular specified allowable extreme fiber stress for bending by more than 25 per cent.

Traction trusses are provided in the plane of the top laterals opposite each expansion point. For the two-track structure the inside stringers are connected by the temporary diagonals and struts shown. In the final three-track structure, double diagonals between the inside stringers are used for one double panel, as indicated in one of the plans.

This work is being done under the supervision of the New York Municipal Railway Corporation, of which W. S. Menden is chief engineer and Francis P. Witner structural engineer, with Jacobs & Davies, Inc., acting as consulting engineers. The designs are subject to the approval of the New York Public Service Commission, of which Alfred Craven is chief engineer. The portion of the Jamaica line already erected was built by Post & McCord, of New York City, and the steel was fabricated by the American Bridge Company.

Technical Report Writing Required at Stevens Institute

A year ago the faculty of Stevens Institute of Technology planned for the introduction of report writing as a requirement for graduation, to be given one afternoon per week during the second half of the senior year. The present senior class is the first to complete this work. The data for these reports are obtained mostly by a search of the literature of the subject, and experimental work is neither required nor encouraged. The subject of the report is chosen by the senior himself during his first term, and is submitted for approval to the head of the department in which it falls. The students are prepared to take up this report writing by exercises which have been introduced into the junior year. The subjects of the reports which have just been submitted by the seniors not only cover branches of mechanical, civil and electrical engineering, but also chemistry, physics, economics and welfare work in industrial organizations.

Inspectors on City Work Should Be Salaried

Employment of Per Diem Men for Extra Work, Such as Opening of Streets, Not Conducive to Loyalty and Good Results

By M. Y. CROWDUS
Nashville, Tennessee

THE CRY for more streets and better ones has brought manifold problems to add to the load already carried by the city engineer of the average American city. Not the least of these is the feature of inspection.

In cities of say 200,000 the city engineering corps ordinarily carried on the payroll are swamped by the additional work which the letting of miles of street contracts puts upon them. Their ordinary duties, coupled with a weekly or semi-monthly estimate day keep their every working hour full. Hence the chances are an extra corps will be put in the field to keep up the engineering work of the new streets alone. Their salaries are not provided for in the yearly budget, and so they are paid out of the special street funds, provisions of the contracts including a lump sum charged to each street. This sum is to cover "engineering and inspection."

The work begins on the new streets, ten or fifteen are started, lines and grades given for them, and an inspector is appointed to see that the excavation, embankments, etc., are true to specifications. Work proceeds until the coming of bad fall weather, the rains, freezes and snows. Work then goes on in a desultory way on some streets, others lie torn up, muddy, half bedded, rain washed all the long winter months. The contractor gets in a day now and then, and so does the inspector. Work a day, and loaf three, or six.

Spring comes again, work starts up where it left off. New lines and grades are needed again, those previously given being destroyed, lost or effaced. The inspector again sings his lay. And then before it seems possible, at the end of the month, the discovery is made that the "engineering and inspection" fund is exhausted on Blank Street and it not half finished! And in spite of the fact that the extra field force has been "laid off" all winter, and the poor inspector has existed somewhat in the nature of Brer Bar. What then is the remedy?

REGULAR INSPECTION FORCE NEEDED

Any city with financial strength to issue bonds for the construction of a half million dollar street contract is, or should be, financially able to provide a regular force of engineers and inspectors to build these miles of streets. Having an overworked engineering corps is as bad business policy as trying to run a million dollar factory on half shift. Nothing is prettier than the workings of a well balanced engineering corps, but put a double load on them and, strive as they loyally will, their efficiency is impaired, their organization is disrupted, and the work is bound to suffer.

The inspection staff should be composed of competent, proved men, sufficient in number to take care of the ordinary year-around work of the municipality, with enough "subs" to call upon when needed. An inspector worthy of the name cannot put his soul into his work when he is continually worried as to whether he will "finish the day" or whether rain will stop him. A salaried position at $75 is more satisfying than a per diem of $3.50 or $4. For a salary of $75 or $90 men can be secured who will pay for themselves in the saving to the city which their constant supervision over works will obtain. And it is right that the taxpayer be assured of getting his money's worth on his street, without having to pay an additional cost for such assurance. Or if provision is made for engineering and inspection to be paid out of each contract, let the fee go into the city treasury to help pay for the services of the men who really pay their own salaries in the stability and durability of the work they supervise.

When a street or sewer is completed and paid for it is too late to discover that the wearing surface is only half the specified thickness, or that the sewer is choked up at a point where the grade was "accidentally" raised and the rate of fall killed.

When the inspector knows that, whether he works three days in the week or six, his check is ready for him at the end of the month, you can depend upon it that pride will insure his getting all that is coming to him in materials and workmanship; or if he is mercenary alone, he knows that he and he alone is responsible for his job; it is up to him, and if the job falls down he is the goat.

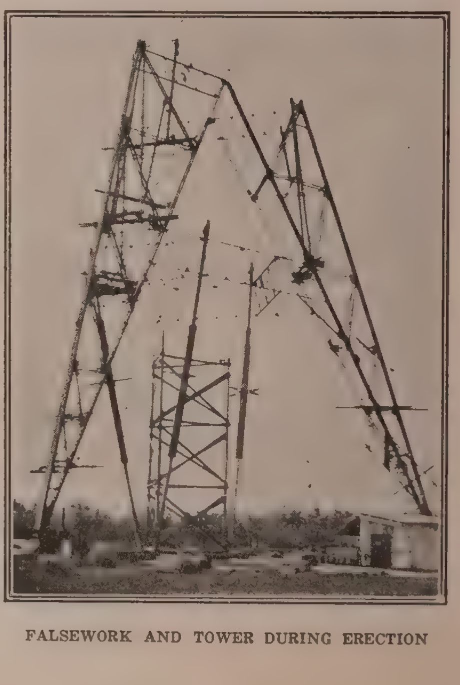
Make the inspector the keystone of the fabric, give him authority, back him up in it, and pay him his worth.

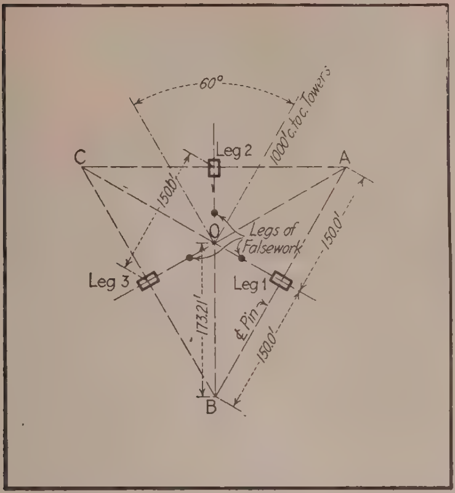
Falsework Complicates Setting of Pins for Large Wireless Tower

By P. E. MOSS WHEAT
Assistant Engineer, Bureau of Public Works, Manila

FALSEWORK already occupying the central area of the location of each tower of the wireless station for the United States Navy at Canacao, Philippine Islands, rendered impossible direct sighting for placing the center pins of the cradles. The method indicated in the sketch was therefore devised for accurately locating these cradles, on the position of which depended the connection where the three legs came together 150 ft. above.

A transit was set at the center of the tower and stakes were driven at *A*, *B* and *C*. The transit was moved to *A* and sighted on *B*, giving the center line of the pin for leg No. 1. The longitudinal center line of


FALSEWORK AND TOWER DURING ERECTION



AS LEGS OF FALSEWORK PREVENTED DIRECT ALIGNMENT OF PINS, CENTERS WERE FOUND BY MEASUREMENT ON LARGE TRIANGLE

the cradle lay midway between *A* and *B*, or 150 ft. from *A*. This distance was measured and transferred to the concrete pedestal at either end of the foundation. The cradle for leg No. 1 was then hoisted and set so that the center line of the pinhole coincided with the line *AB* and the transverse center line passed through the two points set on the foundation. Elevation was determined by direct leveling from bench marks to the top of the cribbing. The other three pins were set in the same manner.

The total height of the towers is 600 ft. They were designed by the Bureau of Yards and Docks of the United States Navy, and the steel work was fabricated in the United States, arriving at Manila on October 29 last.

Production of Manganese Ore Largest Since 1901

The production of manganese ore in the United States in 1915 was 9651 long tons, the largest since 1901, and more than three times the production in 1914, which was 2635 tons, according to figures compiled by the U. S. Geological Survey. The imports of the ore for 1915 were 313,985 tons, as compared to 283,294 tons for 1914. Of this, 268,786 tons came from Brazil—more than twice the quantity received from that country in any preceding year. The imports from India were 36,450 tons, about one-fourth the average of the preceding 10 years. No ore was received from Russia. The quantity of ferromanganese marketed in 1915 was 144,260 tons and the imports were 55,263 tons. The available supply, or 199,523 tons, was greater than that for 1914, but 15 per cent less than the average for the preceding two years. The price of ferromanganese rose to $115 a ton in December, but it is reported that during April, 1916, much higher prices were offered—$175 a ton for future delivery and $400 a ton for immediate delivery. The production of spiegeleisen in 1915 was 114,556 tons, which, with the 200 tons imported, represents an increase of 45 per cent over the available supply for the preceding year. If the increase in the production of steel is considered it becomes apparent that less manganese is now used in the manufacture of steel than formerly, a conclusion that may indicate either that the final product contains less manganese or that ferromanganese is used more efficiently.

City Engineer Defines Quality of Lumber to Use

Chicago Bureau of Engineering Prints Instructions and Bid Prices for Use of Its Designing and Construction Engineers

INSTRUCTIONS as to the kind and grade of lumber to use on different work in Chicago have recently been issued by the Bureau of Engineering for the guidance of all designing and construction engineers on the staff of John Ericson, city engineer. The following notes are abstracted from this 4 x 6-in. pamphlet of 33 pages.

Under the new rules of the Southern Pine Association the terms longleaf, shortleaf and loblolly pine have been discontinued and the terms dense and sound substituted. Following these terms the City of Chicago contracts for three grades of yellow pine lumber, viz., dense merchantable, dense No. 1 common and sound No. 1 common.

This latter class is to be used for all kinds of construction work, including concrete forms, temporary sheds, trench-bracing, shoring, driven sheeting and other work, either temporary or permanent, where maximum strength and durability under severe conditions are not required.

Dense yellow pine No. 1 common grade is to be ordered only where strength and durability are required. It may be used for posts, sills, caps and stringers, bridges and trestles, crib and harbor work, drums and bracing in deep excavations or in treacherous soil, concreting towers and derricks. The same grade is to be ordered only after careful consideration of the advantages to be gained by its use, as compared to the extra cost of sound yellow pine No. 1 common grade.

Dense yellow pine merchantable grade, which is the same as dense yellow pine No. 1 common, except for requirements as to the amount of heart, is to be ordered only where the timber is to be exposed to the weather, and where maximum durability is required.

Norway pine is particularly adapted for bridge railings, sidewalks, scaffolding, foundry flasks, posts for supporting concrete slabs, concrete forms where heavy planking is required, and many of the uses for which No. 1 sound yellow pine is specified. Price, as before, is the determining factor between the two.

White pine, owing to advance in price, may be used only for bridge gates, door jambs, outside finish that requires painting, shelving, bridge-tenders' boats, templates or any other work where ease of working and freedom from warping offset high price.

Kiln-dried white pine is to be used only for mill work, such as windows and doors.

White or burr oak is particularly adapted to uses where its high compression value perpendicular to the grain, its ability to withstand abrasion and its freedom from splintering are necessary. Bridge decking, bridge protection work, dock walings, wedges, skids and scale foundations are some of the uses for which oak may be ordered. In timbers subject to bending stresses, dense yellow pine is to be preferred, as it is approximately 20 per cent stronger in this respect than oak.

Kiln-dried red oak is to be used only for interior finish and cabinet work.

Hemlock, the cheapest lumber contracted for, is the best wood for use in mud and water, and should be used for all kinds of blocking, trench sheeting where driving is not necessary and bracing in ordinary excavation. It can be used for form lumber where the nature of the work requires it to be left in place, and is well adapted for several classes of more or less permanent construction, such as coal sheds and sand and store bins.

Caisson lagging shall be of dressed and matched maple lumber, and shall be tongued, grooved and beveled to fit snugly in the circumference of a circle whose radius will be specified in each order.

All lumber shall be of good quality, live, sound and sawed to standard sizes, full length; it shall have square corners and be straight, with such exceptions are are allowed for the various grades. It shall be free from defects such as injurious windshakes and cross grain, unsound and loose knots and other defects that impair its strength, and must be of grades fully complying with the rules for grading such materials.

Southern yellow pine shall be graded by the rules of the Southern Pine Association. White pine and Norway pine shall be graded by the rules of grading northern pine, spruce and tamarack lumber adopted by the Northern Pine Manufacturers' Association. Oak and maple shall be graded by the National Hardwood Association standard rules for measurement and inspection of hardwood lumber. Hemlock shall be graded by the rules for the inspection of hemlock lumber adopted by the Northern Hemlock and Hardwood Manufacturers' Association.

The last 22 pages of the pamphlet are devoted to bid prices on these grades of lumber.

Engineers Must Learn to Sell Their Ability

Engineering Schools Should Teach Students How to Write Convincingly and to Debate Extemporaneously and Publicly

CLOSELY connected with the current discussion on decrease in registration of engineering students and the possibility of improvements in educational methods is the contention by a prominent alumnus of a Middle Western institution that engineering is an unremunerative profession largely because engineers do not know how to sell their ability. Engineering students, he said, should be taught how to write convincingly and how to debate extemporaneously and publicly. The ethics of the profession is also a matter of vital concern to the engineering schools. Extracts from his remarks follow:

WELL TRAINED BUT POORLY PAID

As an alumnus who comes in contact wtih engineers in all professions, I am satisfied that one answer to the lack of interest in engineering on the part of young men of this country is that it is proving to be an unremunerative profession. I do not believe that any other profession is graduated from the universities so well grounded in its particular art, but the engineers lack an education along certain fundamental lines which are a vital necessity to their success. All engineers must sell their idea or their product, and when they have not been trained in logic and are unable to write or tell in a convincing manner the merits of their design, or are unable to convince capitalists of their superior ability through argument or by written evidence, their engineering superiority goes for naught.

In other words, the best engineers do not rise to the top as quickly as inferior engineers, in many instances, because the inferior engineer is a born salesman. To my mind the engineering profession must have a grounding in logic and argumentation the same as the lawyer, and sell his engineering knowledge as the lawyer sells his knowledge of law. Until engineering schools teach engineers how to write convincingly and debate extemporaneously and publicly the engineering profession will continue to be unattractive to the young man.

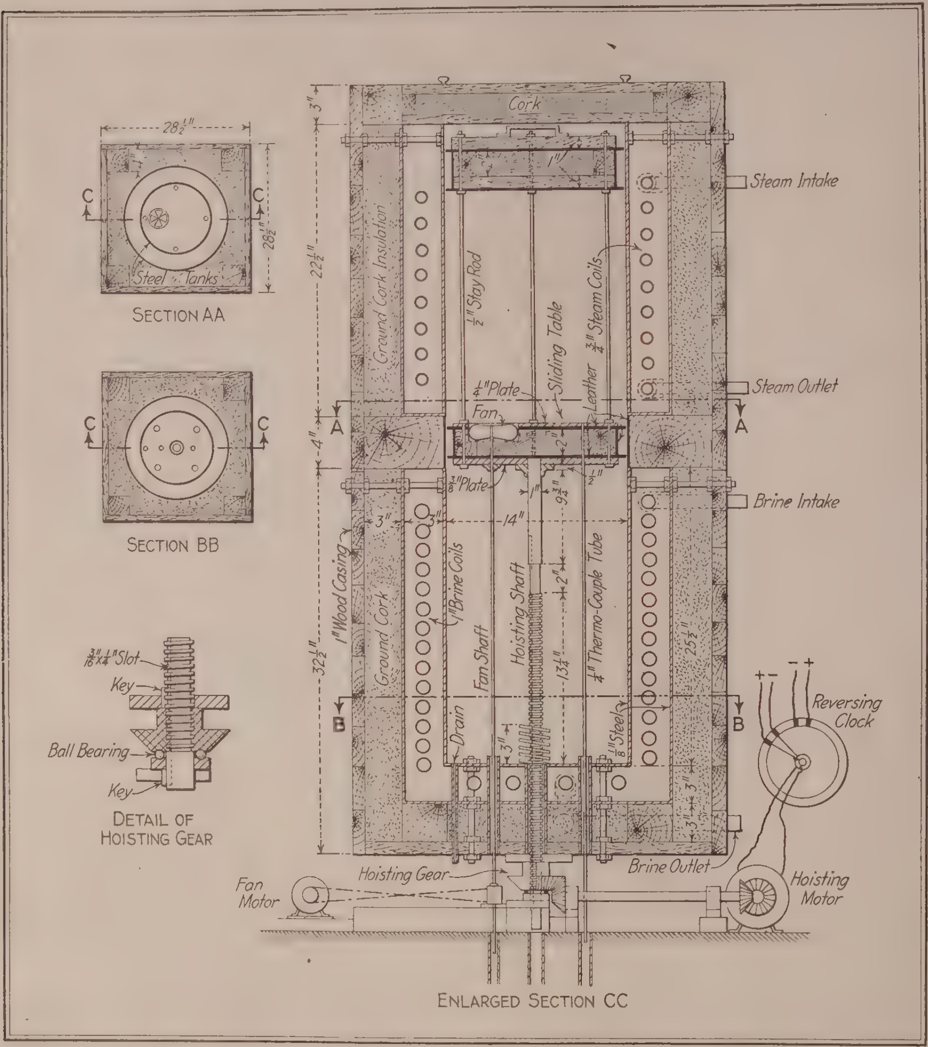
When I make the foregoing statements I am expressing not only my personal opinion, but that of a great many other engineers with whom I have talked along this line. I am so satisfied that my conclusion is correct that I will make every endeavor to keep my two sons out of the engineering profession as a lifework, unless I am first able to give them a straight collegiate course from which they will obtain a grounding which will enable them to write clearly and discuss a subject logically and convincingly.

Finally, the ethics of the profession have not received the attention that they should, and this, too, is a phase of the engineering profession which deserves the most careful attention and consideration on the part of the engineering schools. Just how this could be crowded into a four-year course is a perplexing question, but radical changes of this nature must be brought about.

New Freezing and Thawing Apparatus Is Automatic

Adjacent Insulated Chambers with Steam Coils and Brine Coils Provide Heat and Cold for Testing Stone or Concrete Specimens

FOR THE PURPOSE of testing specimens of stone or concrete to be subjected to freezing and thawing conditions the U. S. Bureau of Standards has devised an apparatus which will automatically shift the specimens from a cold chamber to a hot chamber by the use of a motor regulated by a time clock. Insulation is provided by a simple timber frame with ground-cord lining outside of the steel tanks. A small motor operates a fan to keep the air in the containing chamber in circulation.



SECTIONS OF NEW AUTOMATIC FREEZING AND THAWING APPARATUS

As indicated by the accompanying sections, the apparatus is 28½ in. square and 5 ft. 2 in. high, made up of a timber framework casing surrounding the two ⅛-in. steel tanks within which are placed the steam coils above and the brine coils below. The lower steel tanks are stayed by ¾-in. bolts, four at the lower end and four at the top, while the upper tanks have similar stays at the top. The space between the two lower tanks is to contain oil about the coils, the staybolts being fitted with gaskets to prevent leakage. The brine coils are of galvanized steel pipe, with fifteen turns and a spiral of three turns at the bottom. The steam coils are of ¾-in. galvanized steel pipe having nine turns, held in position by nuts on the threaded ends.

Ball bearings are provided below the hoisting shaft, which is operated by beveled gears from the ⅛-hp. 220-volt hoisting motor. The reduction between the hoisting gear and the driving pinion is approximately 1:3.

The purpose of the coil spring at the bottom is to enable the hoisting gear to pick up the hoisting shaft in the lower position. When the charge occupies the lower chamber the hoisting gear turns loose a few turns in the groove at the upper end of the worm on the hoisting shaft. In this position the coil spring is compressed 1 in. and the strength of the spring is such that the worm on the hoisting shaft is pressed against the lower side of the hoisting gear, so that when the motor is reversed the hoisting pinion can pick up the load. A similar groove is provided at the lower end of the worm on the hoisting shaft so the hoisting pinion can make a few turns loose at the end of the lift.

The motor is reversed by the clock at the intervals required for complete freezing and thawing of the specimens being tested. These intervals are determined by the temperatures in the two chambers, also the size and number of specimens in the test. The contact blocks on the time clock can be shifted to accommodate these intervals, so that for a given charge these blocks are set in the proper place, as indicated by the thermo-couple, to shift the specimens from one chamber to the other when they are completely frozen or thawed.

GENERAL DESCRIPTION OF PARTS

The sliding table consists of a 2-in. disk of cork, two ⅛-in. leather gaskets and two metal plates, ¼ in. above and ⅜ in. below. This is stiffened by four wooden blocks 2 in. square placed where the stay rods pass through. The circumference between the leather gaskets is girthed by a 2-in. band of leather tacked to the wooden blocks. The lower metal plate is secured to the upper end of this hoisting shaft with a ½-in. collar to give additional strength. A 5-in. circular hole in the upper plate is provided for the fan. The sliding cover is of similar construction, as shown, and is stayed to the sliding table by four ½-in. rods turned down to ¼ in. and threaded at each end through table and cover, and provided with nuts and washers. The lid consists of two ½-in. thicknesses of pine separated by 2 in. of cork and made rigid by 2 x 2-in. pine strips at the edges.

The 4-in. wood block separating the two outside chambers is of one piece 26½ in. square with the central opening cut away ¼ in. larger than the inside diameter of the tanks to receive the leather lining shown, and the four corners cut out to pass the 4 x 4-in. corner pieces. A wire basket 12 in. in diameter and 18 in. high of No. 9 steel wire is provided. This containing basket is placed between the sliding table and the sliding cover, and moved up and down from the freezing chamber to the steam chamber at certain regulated intervals.

This device has been designed by D. W. Kessler, assistant engineer physicist of the U. S. Bureau of Standards.

Hypo for Tourists

Hypochlorite tablets to treat suspected drinking water are furnished vacationists free by the Chicago Board of Health. Moline, Ill., put up small bottles of hypo in liquid form for its citizens last year.

Concrete Road Develops Three Cracks in a Year

Fostoria (Ohio) Pavement with Joints 100 Feet Apart Shows Only One Crack Directly Traceable to Contraction

IN 1914 the city of Fostoria, Ohio, laid a concrete pavement 1750 ft. in length and from 15½ to 28 ft. in width, reinforced by wire mesh against frost action, and with transverse joints spaced 100 ft. apart. Portland cement that fell well within the latest amended specifications of the American Society for Testing Materials and aggregates of excellent quality were used. The construction was carried on in a careful manner and was closely watched. After a year's service the pavement developed three cracks, only one of them clearly distinguishable as a contraction crack, and this at a spot at which the subgrade was alternately in a saturated and dry state while the concrete was setting. The other cracks occurred where attempts were made to join new concrete to that of from 12 to 36 hours of age. The following notes in regard to the pavement are abstracted from a paper presented by Charles A. Latshaw, chief engineer of the Department of Public Service of Fostoria, at the December, 1915, meeting of the engineering section of the American Association for the Advancement of Science, at Columbus, Ohio.

Concrete 6 In. Thick

The Sandusky Street concrete pavement, laid in 1914, is about 1750 ft. in length and varies in width from 15½ to 28 ft. A 6-in. thickness of concrete, in the proportions of 1:2:3, was used. The Portland cement used was manufactured by the Sandusky Portland Cement Company, and, as tested by the Pittsburgh Testing Laboratories, fell well within the latest amended specifications of the American Society for Testing Materials. The aggregates were coarse Canadian sand and argillaceous dolomite. The pavement was reinforced 2 in. from the top surface by means of the American Steel & Wire Company's triangle mesh number 36. The strips of reinforcement, 50 in. in width, and overlapping 2 in. at the edges, were laid crosswise to the pavement. The length is constituted of fifteen slabs, approximately 15½ ft. wide by 100 ft. long, and three slabs varying from 15½ to 28 ft. in width and from 40 to 70 ft. in length. Tile varying in size from 4 to 6 in. in diameter was laid about 12 in. below each edge of the pavement. The trenches, around and above, were filled with ½-in. stone. The subgrade was well rolled and smooth. Expansion-contraction joints were of Carey's Elastite, ½ in. thick, armored with Baker plates.

Reinforcing to Resist Frost Cracking

The reinforcing was introduced primarily to resist frost cracking. Temperature cracking was treated as of secondary concern. It was thought safe to assume that the use of the reinforcing would extend at least 10 ft., the natural spacing of contraction joints in plain concrete, as determined by observations made on about 9 miles of unreinforced concrete road in Huron County, Ohio, where natural contraction joints were made by the weather at fairly uniform distances of 90 ft., the conditions of subgrade, quality of concrete and climate being approximately the same.

An inspection of the pavement in December, 1915, revealed only three cracks, all extending the full width of the pavement. One of these was clearly distinguishable as a contraction crack without obvious signs of wear. The others occurred where attempts had been made to join new concrete to that of from 12 to 36 hours of age, situated about mid-length in the slab. Three attempts to accomplish this proved successful to the extent that the most painstaking scrutiny is involved in searching out their location, and it is doubtful if any one not familiar with the construction of the pavement could locate them.

The directions given for joining new work to old between expansion-contraction joints required that the end of the old work be trimmed with a pick or mattock to make a joint perpendicular to the surface of the pavement, that all loose materials be carefully cleaned off by means of a wire broom, that the surface of the joint be carefully washed and covered with a sprinkle of neat cement preparatory to new concrete and that the joints be made at the middle of the width of the reinforcement.

The subgrade at the location of the one contraction crack, while the concrete was setting, was frequently alternating from a saturated to a dry state, and reversely, due to leakage from a faulty catch basin adjacent thereto. A delay in repairing this allowed the full capacity of the structure to empty itself rapidly into the adjacent soil intermittently, for a period of two months after the completion of the concrete paving.

The contraction crack appeared ten days after the concrete was poured, and was probably caused by the extremely frequent and rapid fluctuation of the moisture absorption of the concrete.

The necessity of care being exercised by laborers in shoveling aggregates from soils other than those composed of sand or gravel, to guard against mixing foreign substances into the concrete, was emphasized on the Sandusky Street work. The surface of this pavement here and there displays chunks of loam or clay that were admitted into the aggregates by shovelers who scraped the materials too close to the subgrade.

Literature

For the Civil Engineer and Contractor

New Publications

PORTS OF THE UNITED STATES. Report on Terminal Facilities, Commerce, Port Charges and Administration at Sixty-eight Selected Ports. By Grosvenor M. Jones, commercial agent. Miscellaneous Series No. 33, U. S. Department of Commerce. Paper, 6 x 9 in.; 431 pages; illustrated. Washington, Government Printing Office.

PRACTICAL COST KEEPING FOR CONTRACTORS. By Frank R. Walker. Cloth, 4½ x 7 in.; 273 pages; illustrated. Chicago, published by the author, 30 North Michigan Avenue. $2.

COMMISSION ON BUILDING DISTRICTS AND RESTRICTIONS, CITY OF NEW YORK—FINAL REPORT, 1916. Paper, 7 x 10 in.; 100 pages; illustrated. New York, Board of Estimate and Apportionment, Committee on the City Plan.

EIGHTH ANNUAL REPORT OF THE HYDRO-ELECTRIC POWER COMMISSION OF THE PROVINCE OF ONTARIO, 1915. Paper, 6½ x 9½ in.; 466 pages, illustrated. Toronto, Canada, Legislative Assembly, A. T. Wilgress, printer.

THE THEORY AND PRACTICE OF MODERN FRAMED STRUCTURES. PART III—DESIGN. By the late J. B. Johnson, C. E., C. W. Bryan, C. E., chief engineer of the American Bridge Company, and F. E. Turneaure, C. E., dean of the college of mechanics and engineering, University of Wisconsin. Ninth edition, rewritten by F. E. Turneaure and W. S. Kinne, associate professor of structural engineering, University of Wisconsin. Cloth, 6 x 9 in.; 486 pages; illustrated. New York, John Wiley & Sons, Inc. $4 net.

MECHANICAL ENGINEERS HANDBOOK. Based on the Hütte, and prepared by a staff of specialists, Lionel S. Marks, professor of mechanical engineering, Harvard University and Massachusetts Institute of Technology, editor-in-chief. Limp leather, 4½ x 7¼ in.; 1836 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $5 net.

FIRST REPORT OF THE COMMITTEE ON CIVIL SERVICE OF THE SENATE OF NEW YORK STATE. Cloth, 6 x 9 in.; 933 pages. Albany, J. B. Lyon Company.

Reports, investigations and findings in relation to standardization of the public employments of the state. Tabulates salaries and salary-increase rates, and proposes constructive program of recommendations.

DATA ON THE OXIDATION OF AUTOMOBILE CYLINDER OILS. By C. E. Waters. associate chemist, U. S. Bureau of Standards. Technologic Paper No. 73, U. S. Bureau of Standards. Paper, 7 x 10 in.; 20 pages; illustrated. Washington, Government Printing Office.

AN INVESTIGATION OF THE LAWS OF PLASTIC FLOW. By Eugene C. Bingham, assistant physicist, Bureau of Standards. Scientific Paper No. 278, U. S. Bureau of Standards. Paper, 7 x 10 in.; 44 pages; illustrated. Washington, Government Printing Office.

WATER SUPPLY PAPERS, U. S. GEOLOGICAL SURVEY. Paper, 6 x 9 in.; illustrated. Washington, Government Printing Office.

GROUND WATER IN SAN JOAQUIN VALLEY, CAL. No. 398. 310 pages.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1914. PART 3, OHIO RIVER BASIN. No. 383. 125 pages.

GROUND WATER IN THE HARTFORD, STAMFORD, SALISBURY, WILLIMANTIC AND SAYBROOK AREAS, CONN. No. 374. 150 pages.

SPIRIT LEVELING IN MAINE, 1899 TO 1915. By R. B. Marshall, chief geographer. Bulletin 633, U. S. Geological Survey. Paper, 6 x 9 in.; 55 pages; illustrated. Washington, Government Printing Office.

SAND-LIME BRICK IN 1915. By Jefferson Middleton, U. S. Geological Survey. Paper, 6 x 9 in.; 8 pages. Washington, Government Printing Office.

GEOLOGY AND UNDERGROUND WATER OF LUNA COUNTY, NEW MEXICO. By N. H. Darton. Bulletin 618, U. S. Geological Survey. Paper, 6 x 9 in.; 188 pages; illustrated. Washington, Government Printing Office.

SPIRIT LEVELING IN LOUISIANA, 1903 TO 1915. By R. B. Marshall, chief geographer. Bulletin 634, U. S. Geological Survey. Paper, 6 x 9 in.; 101 pages; illustrated. Washington, Government Printing Office.

STRENGTH AND OTHER PROPERTIES OF CONCRETE AS AFFECTED BY MATERIALS AND METHODS OF PREPARATION. By R. J. Wig, engineer-physicist; G. M. Williams, assistant engineer-physicist, and E. R. Gates, assistant physicist, U. S. Bureau of Standards. Technologic Paper No. 58. Paper, 7 x 10 in.; 172 pages; illustrated. Washington, Government Printing Office.

THE PLANNING OF THE MODERN CITY. By Nelson P. Lewis, chief engineer, Board of Estimate and Apportionment, New York City. Cloth, 6 x 9 in., 423 pages; illustrated. New York, John Wiley & Sons, Inc. $3.50 net.

Books Reviewed

The American Road

Author, James T. Tucker, professor of civil engineering, University of Oklahoma, and consulting state engineer, Oklahoma Department of Highways. Half leather, 6 x 8 in.; 235 pages; illustrated. Norman, Okla.; American Road. $1.08 postpaid.

This is a non-technical manual for practical road builders, though by the thorough manner in which he has dealt with the various subjects, the author has earned a place for his work on the library shelf of the highway engineer. The volume deals with what it styles the "cheap" roads and stops just short of the macadam road, with its modern variations. The illustrations are a striking feature, evidently very painstakingly selected and each one with its terse caption telling a lesson. The necessity of skilled engineering control of highway work is strongly emphasized throughout. Among the subjects dealt with are: General conditions and preliminary studies, road economics, administration, convicts and road work, earth road construction and maintenance, waterways, bridges, finance, stone roads, gravel roads, sand clay roads, building with oils, and needed legislation.

Principles of Depreciation

Author, Earl A. Saliers, Ph.D., instructor in accounting and investments, Yale University. Half leather, 200 pages; tables and forms. New York, Ronald Press Company. $2.50.

REVIEWED BY C. W. STARK

Associate Editor, Engineering Record.

Being written from the accounting point of view, of which the average engineer knows all too little, this book deserves the attention of the engineering profession. Much of the book is pure exposition, clear and convincing, while other sections, which delve into the details of accounting, the reviewer, who is not an accountant, will not presume to dissect. Neither will he attempt to discuss the value of the book to other than engineers. From the engineer's point of view, however, there is one theory that colors the discussion that the reviewer cannot square with justice—namely, that it is right to require the owner of the plant to put up considerably more than $100,000 in order to come out with $100,000 of dividend-paying capital; in other words, that the forced retirement of capital by the amortization of theoretical depreciation down to a feasible condition per cent is entirely proper. Doubtless this simplifies the bookkeeping; but while the reviewer concedes that engineers should pay more attention to accounting principles, he feels that accounting is a means and not an end, and must shape itself to equity.

The book has three parts, devoted respectively to theory, practical applications and the determining of the depreciation charge. In addition there is an appendix with a chapter on logarithms and a selected bibliography that lists six books and twenty-five articles.

The character of the industrial plant is discussed first. A brief discussion of the elements of value is followed by the introduction of the author's view that depreciation should be deducted, being offset by such of the theoretical reserve as has remained in the property, either as a separate fund or as new plant. In chapter 2 the elements of a hydroelectric plant are analyzed, the proportional costs and life lengths of the elements being presented in tables. Chapter 3 shows sample ledger pages, in which the author recognizes the likelihood of estimates of life length and serviceability going wrong by showing adjusted ledger pages, which do not, however, convince the reviewer that either the car that is smashed within a year or the one which is repaired long beyond its theoretical life has been properly accounted for. The author points out in chapter 4 the difference between depreciation and sinking funds, and between funds and reserves, and then in chapter 5 he comes out squarely with the proposition that efficiency and depreciation have no connection with each other—in other words, that the fact that the plant is rendering 100 per cent service should not relieve it from the depreciation deduction.

Part 2, with chapters on regulation, the income tax, valuations and land, contains little that the engineer as such should know and does not. It is worthy of note that the author favors the unearned increment; as so many others do, he regards appreciation as the complement of depreciation.

In part 3 the author gets at the determination of the depreciation charge. Besides an introductory chapter, a short chapter is given to each of six methods. The straight-line, sinking-fund and equal-annual-payment methods are all considered, and in addition there are the reducing-balance, annuity and unit-cost methods. The author leans toward the straight-line method, but explains each briefly and presents depreciation curves obtained by the different methods. While one or two of these methods appear to have no excuse for existing, the engineer should familiarize himself with them, to do which he will likely have to read Part 3 several times, with its formulas and tables.

The book is one that valuation engineers should possess. When engineers become expert accountants they may well choose between this and other discussions of the bookkeeping side of depreciation. At present probably only a few are in a position to discriminate, and even these few are likely to find this volume not without value.

Earth Pressure, Retaining Walls and Bins

Author, William Cain, professor of mathematics, University of North Carolina. Cloth, 6 x 9 in.; 297 pages; 99 illustrations. New York, John Wiley & Sons, Inc. $2.50 net.

REVIEWED BY MELVIN L. ENGER

Assistant Professor of Mechanics and Hydraulics, University of Illinois

Many engineers have no confidence in the usual analyses for determining the thrust against retaining walls because of the assumptions upon which they rest. In particular the assumption that the material behind the wall is a granular mass devoid of cohesion has been frequently criticised as being far from the truth. The inclusion in this book of an analysis which applies to cohesive material will therefore give greater confidence in the theory, although it is probable that conservative designers will continue to neglect the effect of cohesion. One cannot help wishing that large-scale experiments were available for checking the theory and for determining constants. Until experiments are made, and they must cover a large range of conditions to be conclusive, the designer will continue to use "rule-of-thumb" methods or to use one or more of the theoretical methods.

In this book will be found many practical suggestions, graphical methods, detailed designs and tables of great value. It is divided into six chapters and two appendices, as follows: Chapter 1, laws of friction and cohesion, tables, direction and distribution of stress; chapter 2, noncohesive earth, graphical methods; chapter 3, noncohesive earth, analytical methods; chapter 4, design of retaining walls of stone or reinforced concrete; chapter 5, earth endowed with both cohesion and friction; chapter 6, theory pertaining to both deep and shallow bins; appendix 1, stresses in wedge-shaped reinforced-concrete beams; appendix 2, experiments on retaining walls.

The book is a real contribution to its field and should be in the library of every engineer having to do with the design of retaining walls.

Masonry Dam Design

Authors, Dr. Charles E. Morrison, formerly of the civil-engineering department, Columbia University, and Orrin L. Brodie, late assistant designing engineer, New York Board of Water Supply. Cloth, 6¼ x 9 in.; 285 pages; 47 illustrations. New York, John Wiley & Sons, Inc. $2.50.

REVIEWED BY A. G. HILLBERG

Civil and Hydraulic Engineer, New York City

The first edition of this book contained just 100 pages and appeared in 1910. It was entitled "High Masonry Dam Design," its cost was $1.50 and it was reviewed on page 650 of the Engineering Record of May 14, 1910. In the new edition, which comprises nearly three times the number of pages of the first edition, the authors have added chapters on overfall and arched dams and supplied an appendix illustrating the evolution of the masonry dam. Consequently the scope of the book has been extended so that it now covers almost completely the design of masonry dams, including high dams.

Chapters 1 to 5 inclusive, with the exception of minor changes, are identical with the contents of the first edition, while the remainder is new matter. Chapter 6 is a thorough treatise on the design of overfall dams or spillways, and formulas have been deduced covering all possible combinations of loadings, considering static pressure, upward pressure on base, mud pressure on back, dynamic water pressure, and water flowing over the top. The Bazin method of plotting the shape of the falling sheet of water is given, together with methods of how to extend the shape of the sheet beyond the point or points determined by Bazin.

The most interesting chapters are those dealing with the arch dam. As is well known, the stresses in such a structure depend upon a multitude of assumed actions. First, the structure might act as a gravity dam until tension begins to set in at the upstream side; then cantilever action takes place, until the resulting deformations have developed sufficient stresses in the arch to permit arching stresses to obtain. The analysis of an arched dam is by far the most difficult of any kind of dam design, and the authors deserve much credit for the clear and concise way in which this difficult problem has been presented. However, it is likely that the long and cumbersome equations can wholly or in part be replaced by graphical diagrams and charts, thus reducing materially the labor in using them.

In order to shorten as much as possible the explanation and derivation of the formulas, some of the longer derivations have been placed at the end of the book in the form of an appendix. The first of these contains the derivation of the cantilever equations and the other the movements and stresses in an arch subjected to a uniform radial load.

The authors have succeeded in producing an up-to-date treatise on masonry dam design that will be appreciated not only as a text book for students but as a reference book for designers of dams.

State Gets $2,000,000 Road Fees

The exact amount received by the automobile division of the Pennsylvania highway department from automobile license fees up to the close of business June 12 was $2,002,462. The total amount collected from that source during 1915 was $1,665,276.50, which figures were passed April 25 of this year. It is estimated that this year's fees will exceed $2,225,000.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

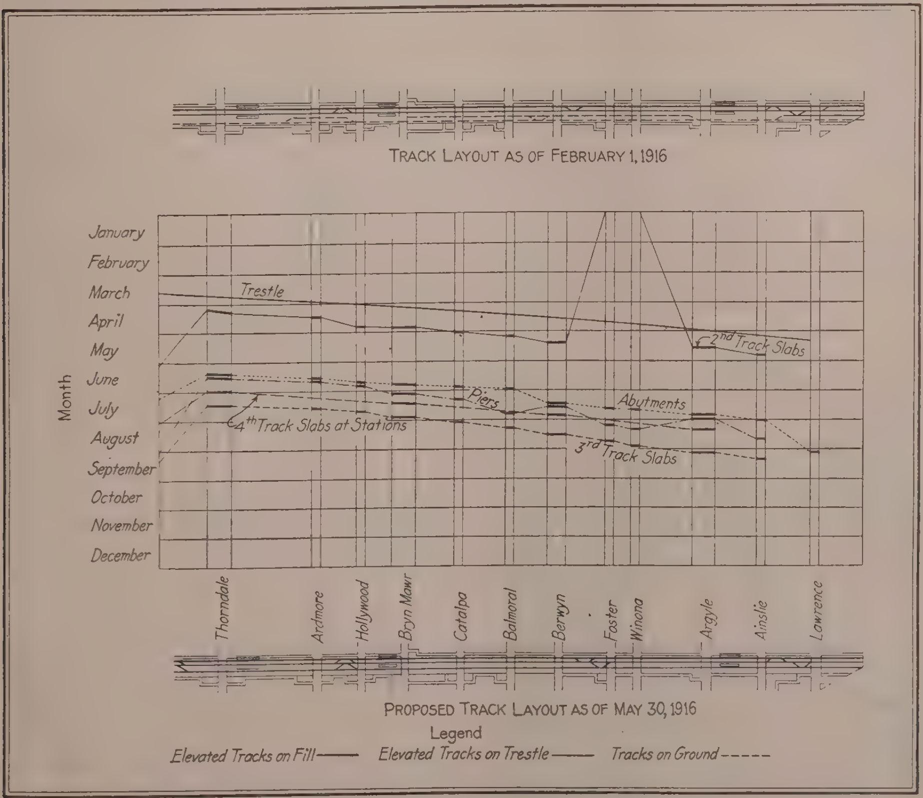
[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Program of Construction Work Shown Graphically

AFTER considerable experimenting C. H. Buford, assistant engineer of the Chicago, Milwaukee & St. Paul Railway, who is in charge of the North Side track elevation work of that road in Chicago, described on page 75, has devised a diagram for the desired progress of his work, a part of which is herewith reproduced. It will be seen that at the top and bottom of the chart are diagrammatic plans showing the streets, tracks and stations as of Feb. 1, before the season's work was started, and as proposed for May 30. In the center section the abscissas correspond to the location, and the vertical spaces are months.

This part of the diagram is self-explanatory. Each part of the work is represented by different conventions. For the trestles and the like, which are continuous, the line is also continuous. Most of the items, however, have to do with the bridges, which are only at the streets, and for these items the heavy lines across the street are connected by lighter broken ones of the proper convention.

The various lines show clearly the desired sequence of operations and the time intervals planned between them.



THIS DIAGRAMMATIC REPRESENTATION OF A TRACK-ELEVATION PROGRAM HAS PROVED VERY SATISFACTORY IN MAINTAINING PROGRESS

Move Brick Refuse Burner on Barge Without Jacking

A BRICK refuse burner at Everett, Wash., has recently been removed from its pile foundation, loaded on a scow, moved to a location several miles distant and set up again without the use of jacks, and without damaging the brickwork in the slightest degree.

The burner rested on sixteen piles cut off about 10 ft. above the ground, which was bare at low tide, and capped with 12 x 12 in. timbers on which rested a deck of 6 x 12-in. timbers. Half of each pile was cut away to a depth of 32 in. below the caps, and eight headers, to carry the track for moving the burner, were spiked securely to the piles at the bottom of this cut. At the next high tide stringers were floated in place and secured below the old caps. On the following tide the track stringers were floated in place, rollers put between the track and the upper stringers, and the track stringers wedged tight from the headers. By cutting away the other half of the pile heads below the track stringers, the refuse burner was left on the rollers ready to move. The barge was brought in at high tide and held in place until low tide, when its end was at the right height to load the burner. This was pulled aboard by two men with a hand winch. The barge floated in 5 ft. of water and was towed to its new location and secured in position for unloading.

BRICK REFUSE BURNER MOVED ON BARGE

Between the sixteen piles of the new foundation sixteen other piles had been driven and cut off 30 in. lower than the permanent piling. The track for unloading the burner rested on these temporary piles. The burner was pulled out on this track, barely clearing the permanent piling. The falsework piling was then cut away, allowing the track, rollers and upper stringers to drop down and leaving the burner on its new foundation.

Accounting for the Contractor: Depreciation and Reserve

By BENJAMIN L. LATHROP
Of Lathrop, Shea & Henwood Company,
Scranton, Pa.

CONTRACTORS' portable plant is subject to more rapid depreciation than the stationary equipment of the average manufacturing or industrial concern. Experience will furnish the best basis for each contractor to assume, but for a practical demonstration let us say that 10 per cent per annum will cover the average loss chargeable to the gradual wearing out of the plant. Before closing the books for the year, an entry in the following form should appear in the journal:

Dec. 31 Depreciation $800
To Reserve for Depreciation.. $800

The depreciation account will be absorbed into the net undivided-profits account, or the annual deficit, as the case may be, and the reserve for depreciation carried over into next year's business as a nominal liability.

The annual percentage charge for depreciation covers only the gradual impairment of the plant's efficiency as a result of wear and tear. Certain definite charges may also be made against depreciation in the event of a destructive accident or the sale of a piece of machinery at less than cost. For example, let us assume that the concrete mixer referred to in the preceding article has been so badly damaged as to be practically worthless, discarded as scrap and sold for $50 to a junk dealer whom, for convenience, we will call Tony Pasquale.

The journal entry would read:

July 15	Tony Pasquale—July	$50	
	Depreciation	750	
	To Plant		$800

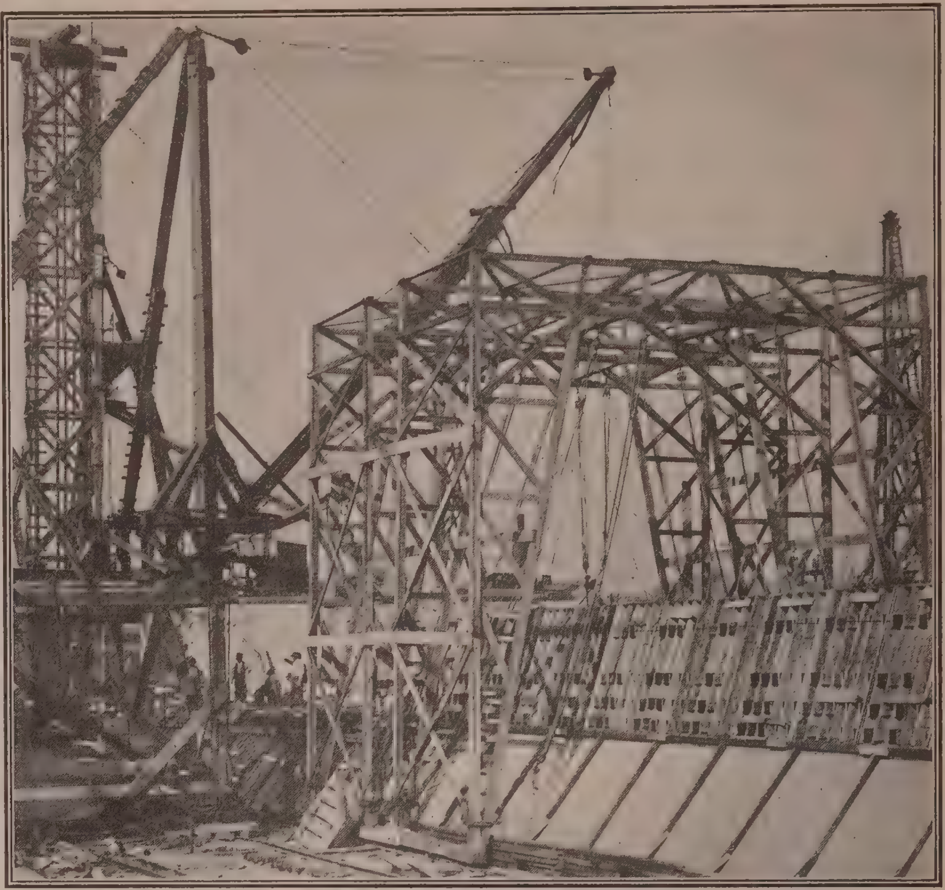
The card describing the mixer would be marked "Sold for scrap, July 15, 1916. See Journal, page ——," and the card removed from the group following the index-card marked "Bridge No. 4," and retired to the back of the file, after an index tab marked "Discard."

A similar treatment would follow the case of a sale of second-hand equipment, though the charge for depreciation would naturally be relatively much smaller.

In the rare but occasional case which may follow a shortage of a certain line of equipment in the market, accompanied by an unprecedented demand, when second-hand plant may be sold at an advance, the profit is credited to reserve for depreciation.

To the account for reserve for depreciation should be charged the cost of new parts purchased to replace those worn out, such as car brasses, bearings, derrick fittings, and the raw materials for repairs. A repair account may be kept, but at the conclusion of the fiscal year it may be carried into the depreciation reserve.

Plant renewals and betterments in general, not otherwise provided for, should also be absorbed by this reserve. Other uses for the account will suggest themselves in actual experience. The account has a compensating value, and while it appears among the nominal liabilities, it is largely in the nature of a variable surplus.



RIG MOVED COMPLETE SECTION OF FORMS FOR ONE LIFT, 128 FEET LONG, IN 9 HOURS

Light Traveler Straddles Reservoir Wall to Handle Forms

A TRAVELER built entirely of 2-in. lumber, of light weight and occupying little room in a space already crowded with construction plant, was recently used to handle sectional wood forms for the dividing wall in a large reservoir in a Western city. The wall, 387 ft. in length, was built in three sections, each 129 ft. long, a complete set of wood forms being constructed for one section and used three times. The wall was divided into four lifts vertically, and the form sections were made 6 ft. long, with a 6-in. fitting space between each section. Those for the bottom lift weighed about 1000 lb. to the section and those for the upper lifts 500 to 600 lb.

The traveler was made as light as possible so that it could be moved by hand, and for this reason was built entirely of 2 x 6-in. lumber, with the exception of the bottom sills and some of the horizontal braces, which were 2 x 10 in. It could have been more economically built of heavier sections, but its weight would have been considerably increased. The traveler was provided with six sets of falls on each side of the wall, each set handling one section of forms. To move a set of forms from one wall section to the next, they were lifted from position with the falls, the lines tied up and the whole traveler, with twelve form sections suspended, was moved down the wall to the point where the forms were to be re-erected; the forms were then lowered and the traveler returned for twelve more sections.

It is stated that a gang of ten men removed a complete section of forms on both sides of the wall, 129 ft. in length, transported and set them on the next section in about nine hours' time. This, of course, did not include the fitting and bracing of the forms in position. The traveler was moved when loaded by means of falls fastened to the bottom sills and to deadmen.

As the working space along the wall was crowded with traveler derricks and other equipment, it is thought that this traveler was by far the most practical and economical means for handling the form sections. It contained about 4800 ft. b. m. of lumber and cost, complete, about $250.

Wheel Scrapers Dumped Through Bridge Over Wagons

By ALBERT S. FRY
Morgan Engineering Co., Memphis, Tenn.

THE PHOTOGRAPH shows the method being used for handling earth in making the excavation for a reservoir which will be one of the units of the flood-protection work now being constructed for the city of Memphis. This work was described on page 775 of the Engineering Record for June 10 last.

A fill was thrown up to an elevation several feet above the street grade. In this fill a timber subway was constructed with a covering of heavy planks. Dump wagons entered the subway from the adjoining street and halted in position with the wagon box under an opening in the subway covering. Wheel scrapers are being used to make the excavation. These, loaded, travel up along the top of the fill until the subway is reached. Here the contents of the wheelers are dumped through the opening in the subway roof into the wagons beneath. When one wagon is full, it pulls out and another takes its place. Enough wagons and scrapers are used so that there is little delay in carrying on the excavation.

WAGONS ARE LOADED RAPIDLY BY WHEEL SCRAPERS DUMPING THROUGH TRAP IN BRIDGE

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Tropical Storm Sweeps Over Southern States

Wind Velocity Reported 105 Miles an Hour—Rainfall at Birmingham, Ala., 14.04 Inches in Five Days—Damage Runs Into Millions

A tropical storm sweeping over the Gulf states July 5 destroyed railroad lines, wharves, telegraph wires, did damage estimated at $7,000,000 and flooded many cities. The storm centered over Pensacola and Mobile and completely destroyed communication with those cities for several days. The rainfall at Pensacola is given as 7.1 in. in a day; at Birmingham 14.04 in. in five days.

Pensacola Naval Station Damaged

Seven navy hydroplanes, the new dirigible hangar and the naval station at Pensacola were damaged to such an extent that $150,000 will hardly suffice for making repairs. Docks were wrecked, ships driven ashore and all telegraph communication destroyed. The rainfall for twenty-four hours was 7.1 in. and the wind velocity reported to be 104 miles per hour from the East. The Louisville & Nashville Railroad bridge across Escambia Bay has been washed away and about eleven miles of track have been damaged by the floods. Estimates from Pensacola give the damage due to the hurricane as $7,000,000. At Tampa the greatest wind velocity was 19 miles per hour and the maximum rainfall 0.43 in. July 4.

Mobile Is Flooded

The damage at Mobile, Ala., is estimated at $3,000,000. The city is inundated for four or five blocks back from the waterfront and the terminal station, located 4½ blocks from the water line, is flooded to a depth of 3 ft. Wharves, coal-handling machinery, buildings and ships have been more or less affected by water and the gale, whose velocity is reported to have been from 70 to 105 miles an hour. The lowest barometric reading of 28.92 was taken at 5 p. m. July 5. Train service between Mobile and New Orleans is impossible.

Bridges Destroyed at Birmingham

Unprecedented floods have been reported from all over Alabama. In Birmingham 14.04 in. of rain fell between the night of July 5 and 3 p. m., July 10, while for July 7 the precipitation was 8.87 in. Estimates by the city engineer give the damage to streets as $50,000 and to roads and bridges about $75,000.

The rainfall at Fort Gaines in one day was more than 9 in., resulting in 5-ft. floods over the railroad tracks. At New Orleans comparatively little damage was done and the wind velocity was only 38 miles per hour.

River Rises 23½ Feet Above Low Water Mark

Swollen by recent rains and melting snow, the Willamette River is reported to have risen 23½ ft. above low-water mark at Portland, Ore. That is the highest stage recorded in several years. Reports from The Dalles, Ore., state that the Columbia River has reached the flood stage of 40 ft. without causing damage.

Roosevelt Recruiting Engineers

In the division of troops which Colonel Roosevelt proposes to raise there will be included a full regiment of engineers. T. C. Desmond, consulting engineer, 110 West Thirty-fourth Street, New York City, is receiving applications for enrollments, assisted by Col. L. H. Grahame, formerly commissioner of public works at Porto Rico.

Appoint Committee on Activated-Sludge Process

Members and associate members of the American Society of Civil Engineers interested in sewage disposal met informally June 28 in Pittsburgh to discuss various problems in connection with the treatment of sewage by the activated-sludge method. The report of the acting secretary, T. Chalkley Hatton, dated July 6, states that the time has not yet come for effecting a permanent organization to avoid duplication of experiments in the United States and Canada and preventing control of the activated-sludge process by patents issued without complete information having been submitted to the commissioner of patents. Believing that the best results could be obtained through a committee and personal service, F. A. Dallyn, provincial sanitary engineer, Toronto; George T. Hammond, engineer of designs, Borough of Brooklyn, New York City, and T. Chalkley Hatton, chief engineer of the sewerage commission, Milwaukee, were appointed to prepare standard definitions and other terms relating to the activated-sludge process of treating sewage. They will also tabulate and distribute a summary of work now being done or contemplated and suggest such correlation of current work as may be desirable.

The question of submitting to the commissioner of patents information relating to priority of knowledge of the activated-sludge process was left with Prof. Earle B. Phelps, H. W. Clark, George T. Hammond and Dr. Edward Bartow, with the understanding that all members present should assist by giving the commissioner all possible information in affidavit form.

Contractors' Association Gives Views on Engineering Society

"The Engineering Record editorially comments on a paper read by James W. Rollins before the Engineers' Society of Western Pennsylvania on unfair contract clauses, and says: 'What is needed is for the engineering organizations, especially the American Society of Civil Engineers, to take a decisive stand and back up the individual engineer with all their influence,' and suggests that the whole subject of contract documents be studied by a competent committee and standards recommended. Highly commendable, and very much to be desired—but not a new idea at all. We don't even claim to have thought of it first, since that has been the underlying thought expressed in all of these papers on contracts for the past score of years. We are, however, skeptical about any assistance from the American Society of Civil Engineers. Long ago we made such a suggestion to this and that influential member of the society, but it meant real work and wasn't received with a bit of enthusiasm. Beyond valuable contributions to engineering literature, the American society has not distinguished itself in any constructive advances or improvements in engineering practice."—*Bulletin, General Contractors' Association, June,* 1916.

Neeld Tunnel Project Killed

The Neeld or South Hills tunnel at Pittsburgh, involving an expenditure of about $1,350,000, of which nearly $50,000 has already been spent, will not be built. The Supreme Court of Pennsylvania recently ruled that the act under which the tunnel was authorized is unconstitutional. It is said that new bills will be presented at the next session of the legislature.

$22,000,000 to Complete New York Subway

Advance in Cost of Material and Labor Affects Estimates to Complete Work—Increase of $7,000,000 on Original Estimate

To complete New York's $350,000,000 subway, $21,834,387 will be needed to provide for the completion of Contracts 3 and 4. In addition, $4,500,000 will be expended for finishing the Sixtieth Street tunnel. The report of Commissioner Travis H. Whitney and Le Roy T. Harkness to the Board of Estimate says that when the 1913 appropriations were made detailed plans for a greater part of the lines had not been made and in some cases the routes themselves had not been determined upon. The estimates were therefore general.

The report shows that construction work under the Brooklyn contract will be nearly $8,300,000 in excess of the original estimates owing largely to the advance in prices of materials and labor caused by the war. As there is more work remaining to be done under Contract 4 than under Contract 3, the war prices have had greater effect on the estimates to complete the work. The item of interest under Contract 4 runs $4,109,000 ahead of the original estimate.

$4,500,000 for Sixtieth Street Tunnel

The report points out that the net increase in the cost of construction work itself is only $7,000,000 on the original estimate of more than $202,000,000 for construction on both contracts. The increased cost so far as construction work proper is concerned is less than 3½ per cent.

The Board of Estimate is reminded that the Sixtieth Street tunnel, to be used as a substitute for the Queensboro Bridge, will also require an appropriation of approximately $4,500,000.

The sum given at the Public Service Commission's office for the entire cost of the subway system when completed is $350,000,000.

President Signs Good-Roads Bill

President Wilson, July 11, signed the Good-Roads Bill authorizing the expenditure of $85,000,000 in five years by the federal government. The provisions of the bill were outlined on page 42 of the Engineering Record of July 8.

Names New York Buildings Board

Mayor Mitchel of New York this week appointed the Board of Standards and Appeals to take the place of the old Board of Examiners. It will have jurisdiction over the building operations in each of the five boroughs. Included in the membership of the new body are Rudolph Miller, chairman, formerly superintendent of buildings of the Borough of Manhattan, and Howard C. Baird, consulting engineer, member of the firm of Boller, Hodge & Baird.

$35,000,000 to Improve Steel Plants

Announcement was made July 11 by Charles M. Schwab, chairman of the board of directors of the Bethlehem Steel Corporation, that $35,000,000 will be spent on improvements for the Steelton and Sparrows Point plants. At Steelton $15,000,000 will be expended and at Sparrows Point $20,000,000. Rolling mills, blast furnaces, plate mills, coke ovens and new tracks are among the improvements planned.

Form $1,000,000 Company for South American Business

The Latin-American Corporation, with a capital stock of $1,000,000, has been organized by the American International Corporation to handle and investigate proposals from South American sources. An expert engineering and construction staff will be maintained to build and supervise the operation of the properties. According to W. S. Kies, vice-president, the new corporation has under consideration many specific projects, including the consolidation and rehabilitation of existing tram lines; the construction of public work, including water-supply systems, sewerage systems and harbor developments, and the construction and development of railways.

University of Iowa Offers Five-Year Chemical Course

The State University of Iowa has discontinued its four-year course in chemical engineering and substituted five years' study of that subject. The new course includes enough mechanical-engineering subjects to acquaint the chemical engineer with those mechanical principles with which he should be familiar. Inspection trips to chemical or metallurgical works are planned and each student is expected to spend at least two periods of six weeks each in the employ of some industrial establishment.

$3,000,000 Deed to Imperial Valley Irrigation System Changes Hands

The deed to the irrigation system in California and Mexico, formerly the California Development Company, has been delivered by the Southern Pacific Company to the Imperial Valley irrigation district. The consideration was $3,000,000 of the district's bonds. This completes the transaction reported in the Engineering Record of Dec. 4, 1915, page 707, and March 4, 1916, page 335, whereby the district acquires control of the irrigation system.

Engineers Organizing in Northwest

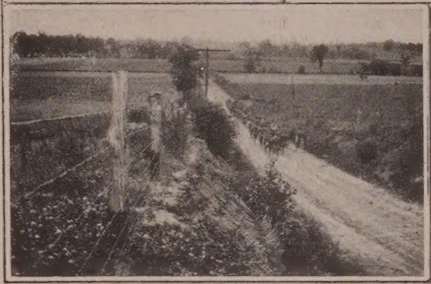
An auxiliary corps of engineers, according to reports from Seattle, is being organized. Technically trained men who would be useful in time of war are being listed according to their qualifications.

Bayonne, N. J., Without Water

The bursting of a main in the Newark meadows last Saturday left Bayonne, N. J., temporarily without water. The situation was partly relieved by sending a supply through an emergency main from Jersey City.

Illinois Engineers Get Active Field Practice at Camp Dunne

THE COMMISSARY DEPARTMENT of the Illinois engineers section of Camp Dunne is a busy and popular place, as evidenced by the upper left-hand picture. "Lined Up to Receive Orders for the Day" would explain the upper right-hand illustration. The center photo is of three Chicago & Western Indiana Railroad engineers—E. V. Powell, A. M. Cornell and D. A. Tomlinson. Six-mile tramps are a part of the camp routine. The lower left picture shows the engineers starting on a cross-country "hike." The advance guard scouts ahead of the main body and transmits the news by the method of signaling illustrated in the lower right-hand photo.



Cloudburst Floods Boston

A terrific cloudburst and thunderstorm that swept over Boston and vicinity July 3 caused more than $100,000 damage in Boston alone. The Washington Street tunnel and the Cambridge subway at Washington and Summer streets were flooded and out of commission for half an hour. Several streets were filled with water to a depth of nearly a foot. The total precipitation for the day is given as 2.3 in.

May Use Cement Sewer Pipe in Seattle

The Board of Public Works of Seattle has agreed to permit the use of cement sewer-pipe specifications. The details are being handled by A. H. Dimock, city engineer.

Engineer Urges Nationalization of Foreigners by Education

In a report to the Chicago Association of Commerce on Americanization and citizenship, Robert Isham Randolph, consulting engineer, of Chicago, chairman of the committee-at-large, holds that the logical agency for carrying on the work of education among adult foreigners can best be done by the public schools. To overcome the difficulties of getting and retaining attendance it is urged that contractors and other employers influence their unnaturalized employees to take advantage of such facilities and prepare themselves for citizenship.

Give Away 600 Meter Boxes

THE Terre Haute (Ind.) Waterworks Company, in twenty minutes, recently distributed more than 600 meter boxes to be used by the citizens of that city as flower receptacles for growing plants

What Engineers and Contractors Are Doing

A. E. BROKER has resigned as assistant highway engineer for Milwaukee County, Wisconsin, to become superintendent for the Chickamauga Quarry & Construction Company, at Savannah, Ga. The Chickamauga company has a contract for the concrete work on the Savannah Warehouse & Compress Company's new building near Savannah.

CARL B. ELY, formerly assistant superintendent of the bridge and construction department of the Steelton plant of the old Pennsylvania Steel Company, has been made superintendent of that department, succeeding Thomas Earle, transferred to Bethlehem. Mr. Ely was graduated from Yale University in 1900 and then served as apprentice in the Altoona shops of the Pennsylvania Railroad for two years. For a few months in 1902 he was in charge of inspecting and testing at the steel rail plant of the Consolidated Lake Superior Company and in October of that year joined the Pennsylvania Steel Company. In 1904 he was made assistant engineer and a few years later was promoted to the assistant superintendency of the department of which he is now the head.

George L. Hosmer, formerly assistant professor at the Massachusetts Institute of Technology, has been made associate professor of topographical surveying at the institute.

Warren W. Inglis, who for the past two years has been engaged as engineer on the design of the new plant of the Remington Arms-Union Metallic Cartridge Company, has been made resident engineer at the Benson mines, at Benson Mines, N. Y.

Eugene C. Miles, formerly associate editor of the Engineering Record, has been made editor of the *American Gas Light Journal*, New York City. Mr. Miles was graduated from Pennsylvania Military College in 1906 and from then until early in 1908 served on the engineering forces of the Pennsylvania Railroad on the East River and land tunnels, New York City. He left the employ of the Pennsylvania to become assistant engineer in the department of public works of the Republic of Cuba. He returned to New York City the following year and until June, 1910, was engineer for the Hanover Contracting Company on the installation of water mains and appurtenances in the boroughs of Manhattan and Richmond. He was made engineer on wharf construction at Port an Prince, Haiti, for the Empire Engineering Corporation, of New York City, in June, 1910, but resigned in September of that year to return to the Hanover Contracting Company. He joined the staff of the Engineering Record early in 1915.

W. Staley Wicker, after serving for nearly a year as assistant engineer on highway construction in Davidson County, North Carolina, has resigned to become building inspector for the Atlantic Coast Line Railroad.

R. L. Daugherty, assistant professor of hydraulics in Sibley College, Cornell University, has resigned and has been appointed professor of hydraulic engineering in Rensselaer Polytechnic Institute, succeeding Prof. Lewis F. Moody, who has resigned to enter private practice. Professor Daugherty was graduated from Leland Stanford University in 1909 and for one year thereafter was instructor in experimental engineering at his alma mater before going to Cornell. He is the author of "Hydraulic Turbines," "Centrifugal Pumps" and "Hydraulics."

George W. Fuller, consulting engineer of New York City, has been awarded the Edward Longstreth medal of merit by the Franklin Institute, Philadelphia, for his paper on "Biochemical and Engineering Aspects of Sanitary Water Supply." The paper, which was published in the "Journal" of the institute in July, 1915, was a comprehensive description of practical means of measuring the sanitary quality of water supplies.

Robert A. Cummings, Jr., who was graduated from the civil engineering course at Yale University last month, will shortly enter the office of his father, Robert A. Cummings, consulting engineer, Pittsburgh.

Prof. A. N. Talbot, of the University of Illinois, the well-known authority on reinforced-concrete, was honored with the degree of doctor of engineering by the University of Michigan at its commencement exercises late last month. The University of Pennsylvania conferred the degree of doctor of science on him last year. Professor Talbot, in addition to his services on various technical committees on concrete, is chairman of the committee on track stresses of the American Society of Civil Engineers, a past director of that society and also a past-president of the American Society for Testing Materials.

Earle C. Waite has been promoted from structural engineer for the Bethlehem Steel Company to civil engineer in the office of the vice-president in charge of securing raw materials.

L. R. Talbot was recently made construction engineer for the Shawinigan Water & Power Company, at Shawinigan Falls, Quebec, Canada. Mr. Talbot will work on the storage dam on the upper St. Lawrence River and on the construction of a transmission line.

James L. Tighe, consulting hydraulic engineer, of Holyoke, Mass., has been engaged by the board of public works to assist in estimating the value of the Springfield waterworks. Mr. Tighe was connected with the Holyoke engineering department for 19 years, and resigned to engage in consulting practice about six years ago.

William H. Kavanaugh, professor of experimental engineering at the University of Minnesota, will Sept. 1, become connected with the University of Pennsylvania in a similar capacity. Professor Kavanaugh has been a member of the faculty of the University of Minnesota for fifteen years, the last nine as head of the department of experimental engineering.

Henry O. Pond has resigned as mechanical engineer for Westinghouse Church Kerr & Company to take charge of the timber, pulp and water-power interests of E. B. Cadwell & Company, New York City.

Arthur Lederer has resigned as chief chemist for the Sanitary District of Chicago to study the course for health officers at Harvard-Technology.

R. E. Koon, consulting engineer, of Portland, Ore., will be in charge of the engineering work in connection with the construction of the 26-mile Sultan River pipe line project for which the contract was let June 5. The work, which involves the expenditure of about $600,000 and will furnish a new source of water supply for the city of Everett, Wash., will be completed late in 1917. Mr. Koon made the surveys for the Sultan River project as the representative of Burns & McDonnell, consulting engineers, of Kansas City.

Eliot N. Smith, formerly with the firm of Smith, Hauser & McIsaacs, New York City, has been made supervisor of the recently created bureau of engineering of Nutley, N. J. After being graduated from Oberlin College in 1900 Mr. Smith spent four years at Harvard University. Upon graduation he was made instrumentman for the Massachusetts State Harbor and Land Commission and in August, 1904, became connected with the Rapid Transit Railroad Commission, New York City. He was assistant engineer at the time of his resignation in 1906, when he accepted a similar position with the Board of Water Supply, New York City. Mr. Smith resigned after nine years' service with that board to become associated with Smith, Hauser & McIsaacs.

A. D. Ludlow, engineer and contractor, was recently made sewer engineer in the department of engineering, Kansas City, Mo. For two years after being graduated from the University of Kansas in 1894, Mr. Ludlow was structural steel draftsman for J. A. L. Waddell, consulting engineer, Kansas City. He spent the next five years as designer of sewers and metal structures in the city engineer's office. In 1902 he was made assistant engineer for the Kansas City Southern Railway, but in 1907 returned to the engineering department of the city as assistant engineer. During the construction of the new station and terminal Mr. Ludlow was assistant engineer for the Kansas City Terminal Railway, his period of employment by that road extending from July, 1909, to October, 1912. While with that company he designed the $1,000,000 O. K. Creek sewer described in the Engineering Record for Nov. 2, 1912, page 480. Mr. Ludlow entered the contracting field in 1912, specializing in reinforced-concrete and sewer construction. The Kansas City sewer department was recently reorganized to handle a large amount of work that has accumulated during the past two years, including the $1,750,000 Blue River sewer provided for in a recent bond issue.

Edmund T. Perkins, consulting engineer, of Chicago, has been appointed a member of a new committee of the Chicago Association of Commerce on military and naval affairs. The work of the committee will include soldiers' relief and welfare, relief of soldiers' families, recruiting, transportation and sanitation.

Frank G. White, who for the past five years has been with the State Harbor Commission of California, where he had risen to the position of principal assistant engineer, was July 7 made chief engineer of the commission. Mr. White is a graduate of the University of Iowa, class of 1899.

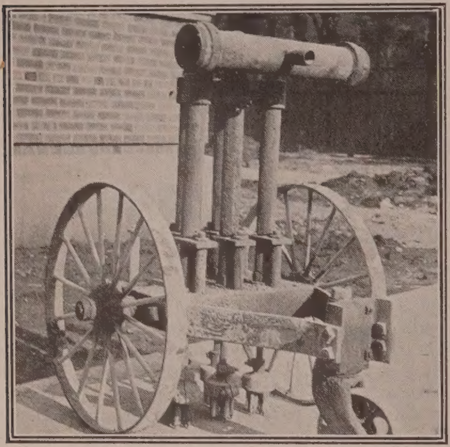
Obituary Notes

Joseph Ramsey, Jr., president of the Lorain, Ashland & Southern Railroad and past-president of the Wabash Railroad, died July 7 at his home in East Orange, N. J., at the age of 66. Mr. Ramsey was born at Pittsburgh, Pa., in 1850 and was educated at the Western University of Pennsylvania. He entered railway service in 1869 as a member of the engineer corps of the Pittsburgh, Cincinnati, Chicago & St. Louis Railway and was later engaged by different railways on engineering work until his appointment as engineer for the Bell's Gap Railroad in 1872. After a year's service he was made chief engineer and superintendent for that road, in which position he remained until 1879, when he resigned to take a similar position with the New Castle & Lake Erie. He left that road after ten months' service to become chief engineer and superintendent for the Pittsburgh Southern Railroad. He was made chief engineer and general manager for the Pittsburgh, Chartiers & Youghiogheny Railroad in 1882 and in the next year held a similar office with two other railways and with the Chartiers Block Company. In 1883 he was made engineer and in 1886 chief engineer for the Cincinnati, Hamilton & Dayton. January of 1890 found him assistant to the president of the Cleveland, Cincinnati, Chicago & St. Louis Railway, which office he held until the middle of the following year. Indications of Mr. Ramsey's executive ability rapidly became apparent in 1890, when he was made president of the Peoria & Pekin Union Railway in addition to his other offices. Appointments to executive positions with various roads followed closely during the five years which preceded his appointment as vice-president and general manager of the Wabash Railroad in 1895. He was elected to the presidency of that road in 1901. He resigned in 1905. Mr. Ramsey was president of the following railroads for the periods indicated: Wheeling & Lake Erie, 1901-05; Western Maryland and West Virginia Central & Pittsburgh, 1903-05; Ann Arbor, 1902-05 and 1910-12. He was made president of the Ashland & Western Railway and the Lorain, Ashland & Southern Railroad in 1910 and president of the Wheeling & Lake Erie in 1912.

Robert M. Roy, general manager of the Hamilton Bridge Works Company, Ltd., Hamilton, Ontario, died recently in that city. Mr. Roy began his engineering career in 1886 in the engineering department of the Grand Trunk Railway, where he was employed until going to the Brown Manufacturing Company, Belleville, Canada, in 1888. After four years with the Brown company Mr. Roy resigned to take a position with the Central Bridge & Engineering Company at Peterboro. He left the latter firm in 1898 to become assistant engineer of construction for the Hamilton Bridge Works Company. He remained with the company continuously until his death.

Chip Floors for Top Coat with Pneumatic Hammers

A bond between slab and wearing surface of the concrete floor in the new office and record building of the Chicago & North Western Railway in Chicago is being accomplished by chipping the slab surface with pneumatic chipping hammers. By the hand-and-pick method 80 sq. ft. is an 8-hr. day's work. With the specially adapted equipment shown in the photograph three men using one five-gun and two single-gun chipping hammers can roughen more than 3000 sq. ft. per day. The five-gun hammer is used for most of the work and the single-gun hammers for trimming around the edges and columns.



FIVE-GUN HAMMER CHIPS CONCRETE

Paul J. Kalman & Company, St. Paul, have the contract for the floor work. Their superintendent, Charles E. Cook, estimates that the cost is reduced 60 per cent over hand methods and the efficiency of the bond materially increased. The special hammers, which were furnished by the Kellar Pneumatic Tool Company, Fond du Lac, Wis., were supplied with air by a Zin-Ho portable air compressor.

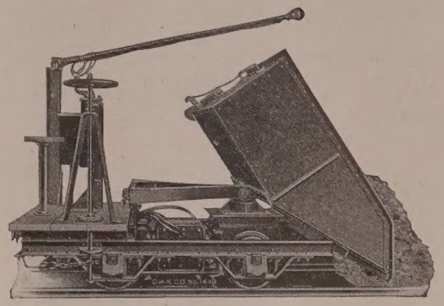
Portable Stone Unloader Costs Little to Install

One of the claims made for the Burch stone unloader is that its cost of installation is small, as a pit about 30 in. deep by 32 in. wide is all the excavation necessary. The belt conveyor travels 225 ft. per minute and delivers stone to the wagon at the rate of 1 cu. yd. a minute. The machine is so constructed that the end of the elevator will be 7½ ft. from the ground with the wagon 20 ft. away from the track. It is also said that stone can be carried with the belt at an angle as great as 29 deg. The unloader is operated by an Alama gasoline engine.

The Burch unloader is manufactured by the Burch Plow Works Company, Crestline, Ohio.

Motor-Driven Dump Car Claimed to Increase Efficiency

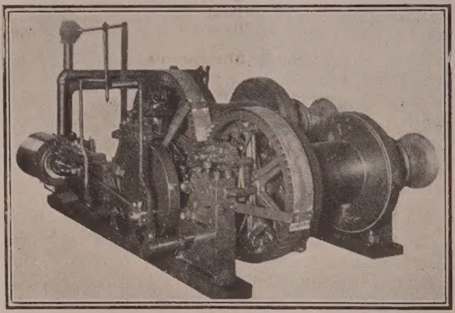
A material reduction in the cost of disposing of waste material is said to be effected by the use of a motor-driven dump car made by the Orenstein-Arthur Koppel Company, of Koppel, Pa. The car is 9 ft. 8 in. long, 5 ft. 10 in. wide and 4 ft. 8 in. high and has a capacity of 54 cu. ft. It is made to fit any gage from 36 in. to standard and is furnished for use where either alternating or direct current is available. One man can handle the car.



MOTOR-DRIVEN DUMP CAR SAID TO REDUCE COST OF DISPOSING OF WASTE MATERIAL

Band Friction Used on Hoist

A newly designed steam hoist equipped with band friction to eliminate end thrust is made in six sizes varying from 7 x 10-in. to 12 x 12-in. cylinders, by the Thomas Elevator Company, Chicago. Other features of this line of the double-cylinder-type hoist are the solid-cast bedplate, cut steel gears throughout, adjustable cross-head gibs, straight-line valve action and a solid-end connecting rod.



NEW STEAM HOIST HAS BAND FRICTION

Donate Trucks to Aid Militia

The work of moving supplies from the Georgia state arsenal to the freight depot at Atlanta last week was done by Smith Form-A-Trucks. The Smith company donated three trucks for use in hauling the material. More than five carloads of supplies weighing about 70 tons were thus transported.

UNLOADER CARRIES STONE AT ANGLE OF 29 DEGREES

Business Notes

F. T. Kern and **M. R. Hunter** have formed the firm of Kern-Hunter, Inc., First National Bank Building, Milwaukee, Wis. The organization is Wisconsin and northern Michigan representative for a number of companies selling to contractors. Mr. Kern has been in the contractors' equipment field in Milwaukee for ten years. Mr. Hunter was formerly a member of the editorial staff of the Engineering Record.

Lidgerwood Manufacturing Company of New York City has removed its Seattle office to 65 Columbia Street.

O. K. Clutch & Machinery Company of Columbia, Pa., has moved into new and larger quarters in that city.

Herman Nieter, formerly sales manager for the Kennicott Company, Chicago, and later manager of the New York office of the Blaw Steel Construction Company, is now with the American Spray Company, New York City, as sales engineer.

E. R. Marker, district manager for the T. L. Smith Company, Milwaukee, has removed to 609 Wells Street, where he has a complete line of mixer and other contractors' equipment on hand.

Trade Publications

The following companies have recently issued trade literature:

The Pelton Water Wheel Company, San Francisco and New York. Four-page folder, 8 x 11 in., devoted to Pelton waterwheels. Outlines information required for analysis of a proposed water-power development and illustrates different uses to which such power can be put.

The Austin-Western Road Machinery Company, Chicago. Circular, 8 x 11 in., 8 pages. Shows the Austin pneumatic road scarifier in operation attached to the Austin motor road rollers.

National Tube Company, Pittsburgh. Catalogue, 8 x 10 in., 72 pages. Aside from showing many reasons why National pipe should be used the booklet contains pictures and drawings showing damage resulting from installations of poor pipe. Almost every page boasts a picture of a National installation showing some point of unusual interest.

The Parsons Company, Newton, Iowa. Booklet, 6 x 7 in., 12 pages, describing two models of the Parsons backfiller with caterpillar traction. Illustrated with pictures of the machine in operation.

Blaw Steel Construction Company, Pittsburgh. Bulletin 69, 7 x 10 in., 24 pages. Illustrated with photographs of practically every kind of Blaw steel forms for road, sidewalk, curb and gutter work and giving the distinct use of each form. A few of the 15,000 jobs on which Blawforms have been used are also shown.

The Wellman - Seaver - Morgan Company, Cleveland. Circular, 9 x 10 in., 8 pages. Describes and illustrates the Johnson hydraulic valve for water-power plants and supply systems. Shows one of the 8-ft. Johnson valves used by the Salmon River Power Company and the 12-ft. Johnson valve built for the Utah Power & Light Company.

Trussed Concrete Steel Company, Youngstown, Ohio. Volume entitled "Kahn Road Book," 5 x 8 in., 128 pages. The first part contains a general historical review of concrete pavements as well as tables giving cost data. The reinforcing of concrete pavement is thoroughly discussed, under which heading the Kahn road mesh is described. Expansion joints and the necessity for protecting the edges occupy another section, in which is included information regarding Kahn armor plates and the installing device. Specifications for concrete highways are included with pictures of that kind of roads.